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MANAGEMENT:

A Tool for Conservation Practitioners

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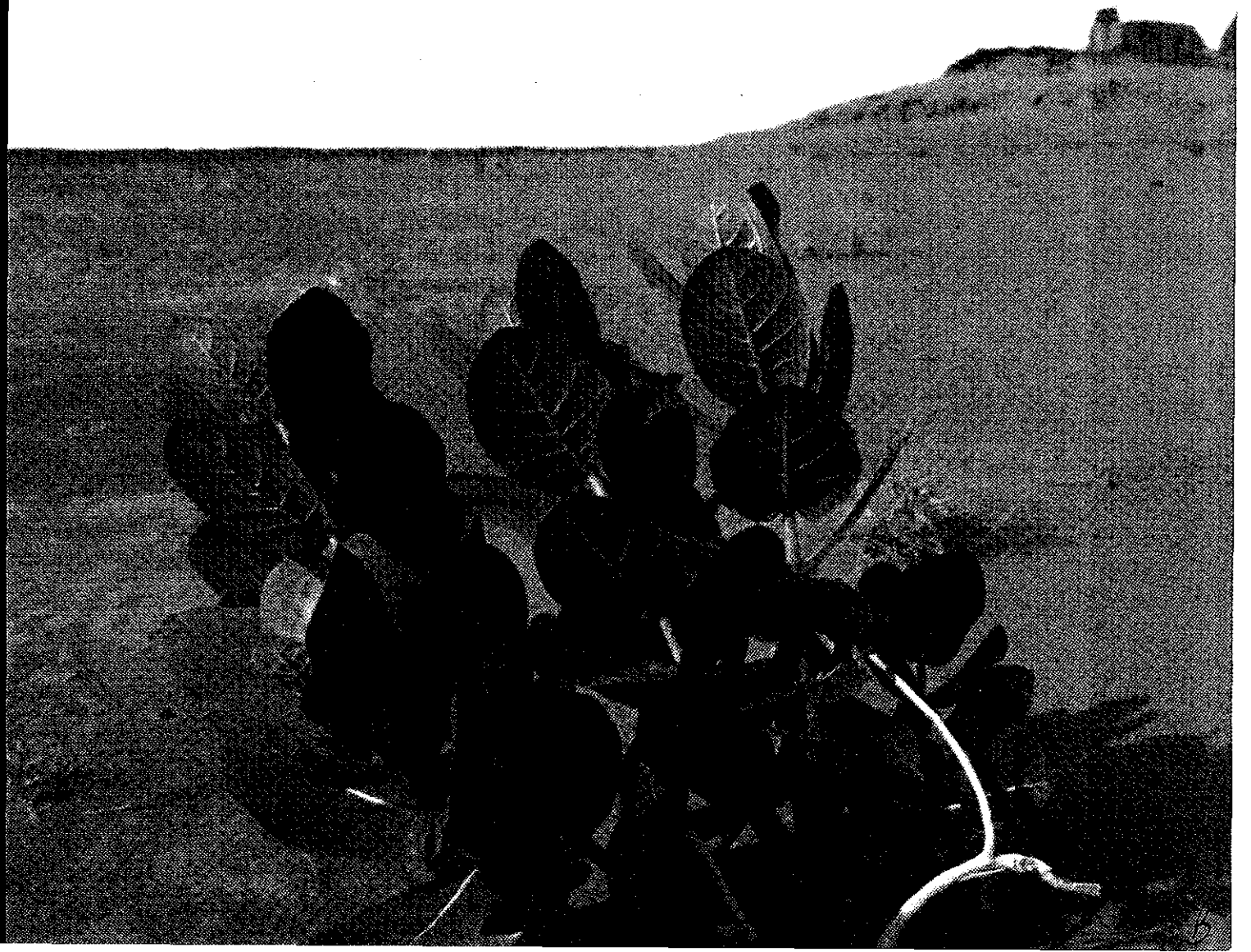
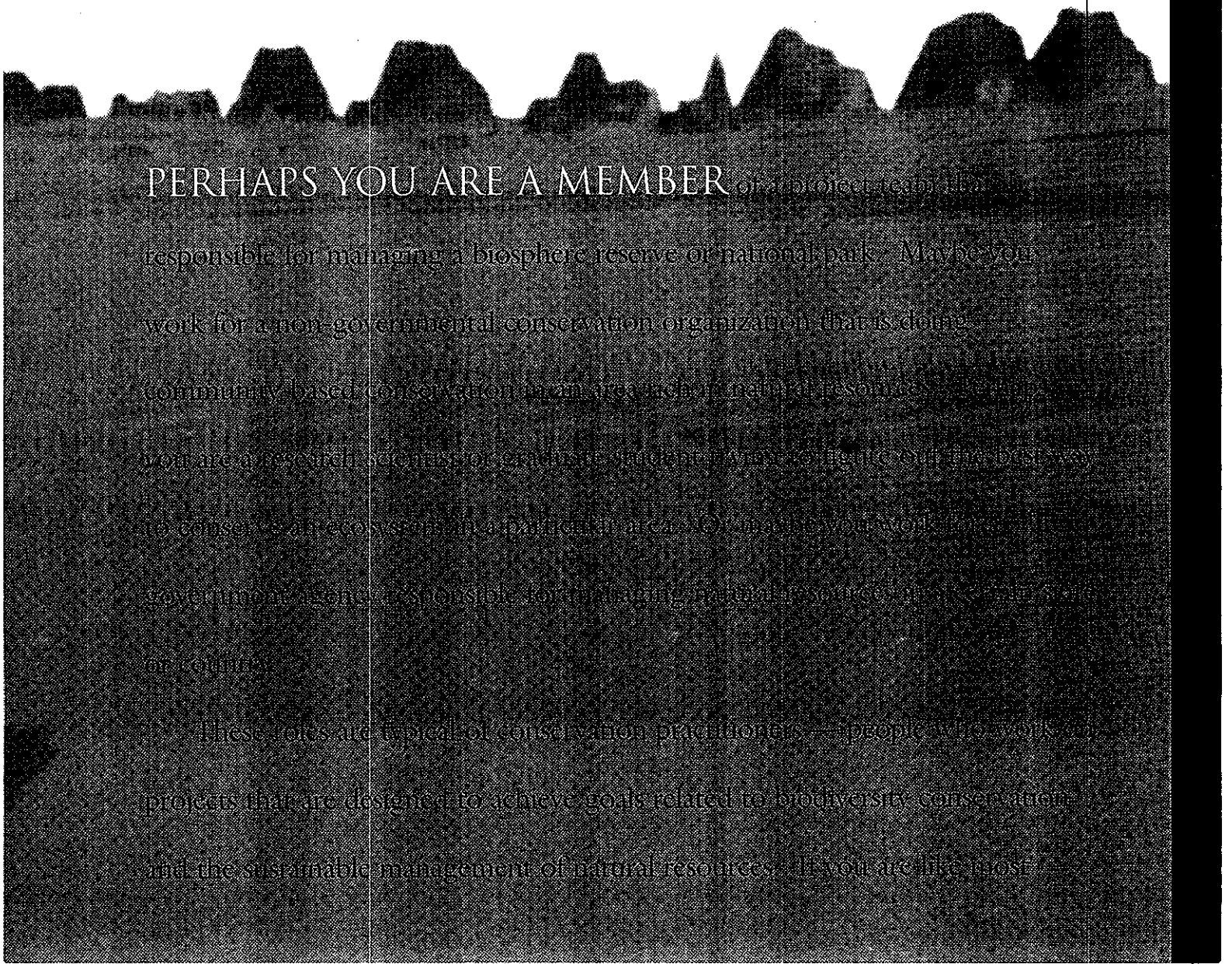


ADAPTIVE MANAGEMENT:

A Tool for Conservation Practitioners



PERHAPS YOU ARE A MEMBER of a project team that is responsible for managing a biosphere reserve or national park. Maybe you work for a non-governmental conservation organization that is doing community-based conservation in an area rich in natural resources. Or you are a research scientist or graduate student investigating effective ways to conserve ecosystems in a particular area. Or maybe you work for a government agency responsible for managing natural resources such as forests or fisheries.

These roles are typical of conservation practitioners—people who work on projects that are designed to achieve goals related to biodiversity conservation and the sustainable management of natural resources. If you are like most

other conservation practitioners, your work requires a wide range of skills including managing staff, dealing with boards, funders, and bosses, communicating with stakeholders, and understanding the biology and culture of the places in which you work. But perhaps more importantly, your job requires understanding and managing information in ways that maximize your conservation results.

Like many other conservation practitioners, you have probably asked the following questions as you have managed your project:

- How can we best understand the conditions at the site where we are working?
- What goals should we be trying to accomplish?

- What actions should we take to efficiently achieve our goals?
- How do we measure our success and the extent to which our actions contributed to change?
- What can we do to work more effectively in the future?
- How can we capture what we have learned so that we don't make the same mistakes again?
- How can we share our findings with other practitioners?

If you have ever asked yourself questions like these, then you have begun the process of adaptive management.

WHAT IS THIS GUIDE ABOUT?

THE FIELD OF BIODIVERSITY CONSERVATION

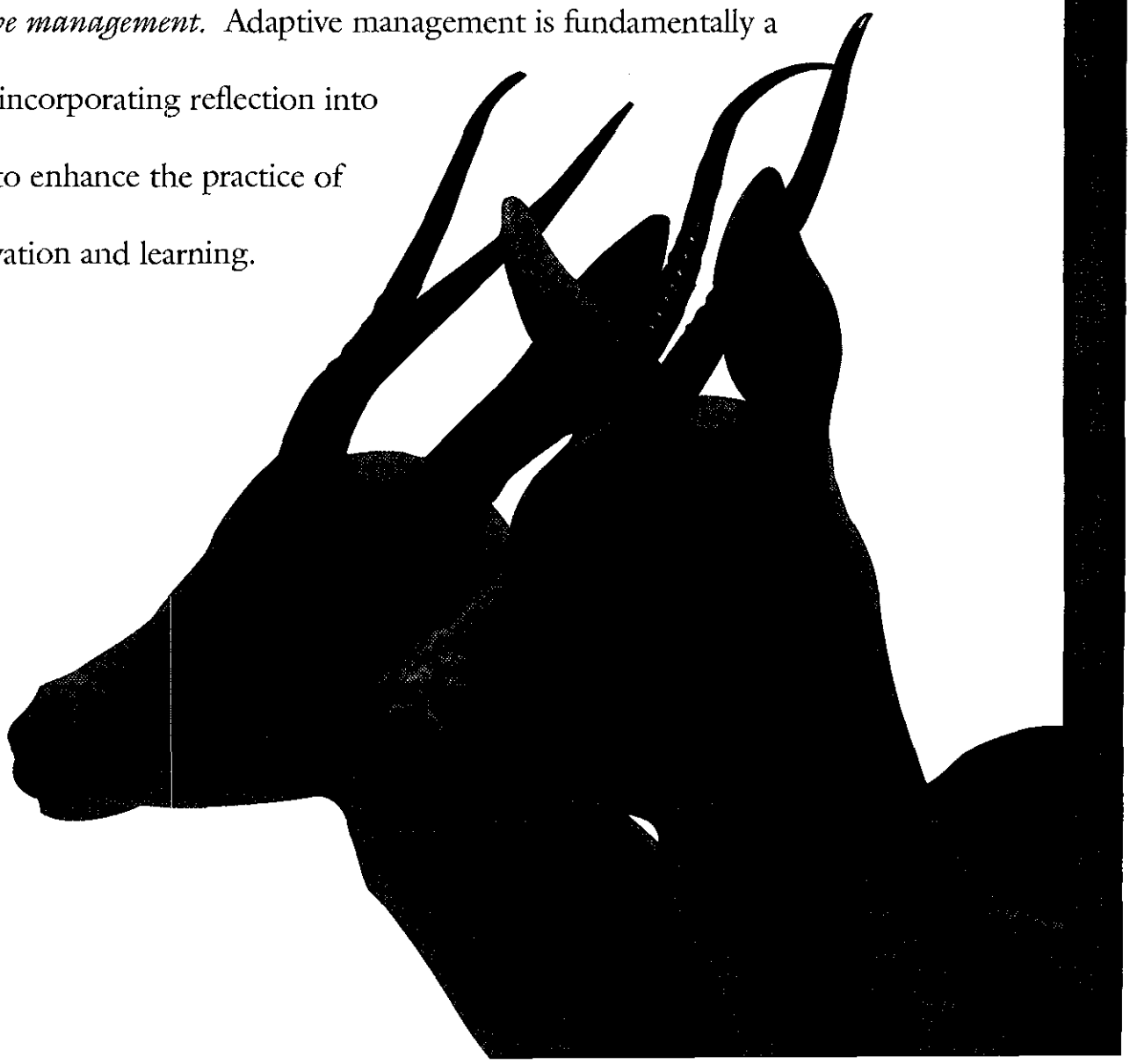
is at an important point in its evolution. Over the past few decades, we have discovered why conservation is important to maintain life on Earth. We have identified many of the species and ecosystems that are at greatest risk of going extinct. And we have begun to develop tools and techniques that can help counter the growing threats to biodiversity.

At the same time, as the field matures, the conservation community is also facing a number of new and more difficult challenges. Perhaps foremost amongst these is the recognition that despite decades of hard work, hundreds of projects, thousands of trained professionals, and millions of dollars, we have not yet substantially slowed the destruction of forests, grasslands, and aquatic ecosystems. It is clear that business as usual is not a viable option and that newer, more powerful approaches must be tried.

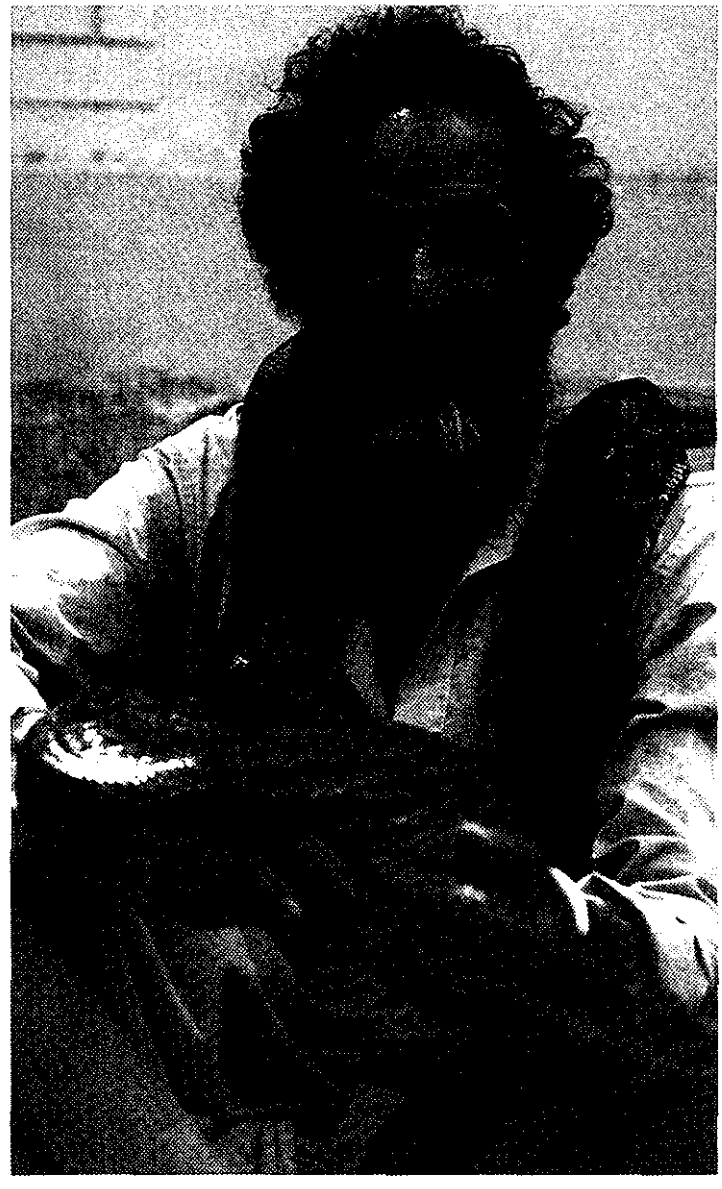
Conservation practitioners are facing increasing pressure from donors, governments, local stakeholders, and society as a whole to demonstrate clear and tangible results. To this end, they are trying to develop workable monitoring and evaluation systems. Conservation practitioners are also challenged by limited financial and human resources to become more effective

in using different tools and techniques in their work. As a result, they have begun examining what works, what doesn't, and why. And finally, conservation practitioners are being asked to capture what they have learned and pass it on to other practitioners so that we can avoid making the same mistakes over and over again and can begin generating new knowledge. They have thus begun to try to create learning projects and learning organizations.

Monitoring and evaluation, testing what works and what doesn't, and creating learning organizations are all components of an approach called *adaptive management.* Adaptive management is fundamentally a way of incorporating reflection into action to enhance the practice of conservation and learning.



Objectives of This Guide



The term "adaptive management" has been used primarily in academic circles since the 1970s, but until recently, has had little relevance for conservation practitioners. In recent times, the term has become a confusing buzzword that means many things to many people — as one person told us, "Adaptive management is merely an excuse to change your mind." We believe that this perceived lack of relevance and confusion occur largely because adaptive management has not been clearly defined or explained in operational terms. Our interest in writing this guide has grown out of a desire to help bring some conceptual clarity to the concept of adaptive management and to determine ways in which it can be harnessed and used more effectively by conservation practitioners. To achieve these aims, we began with seven objectives:

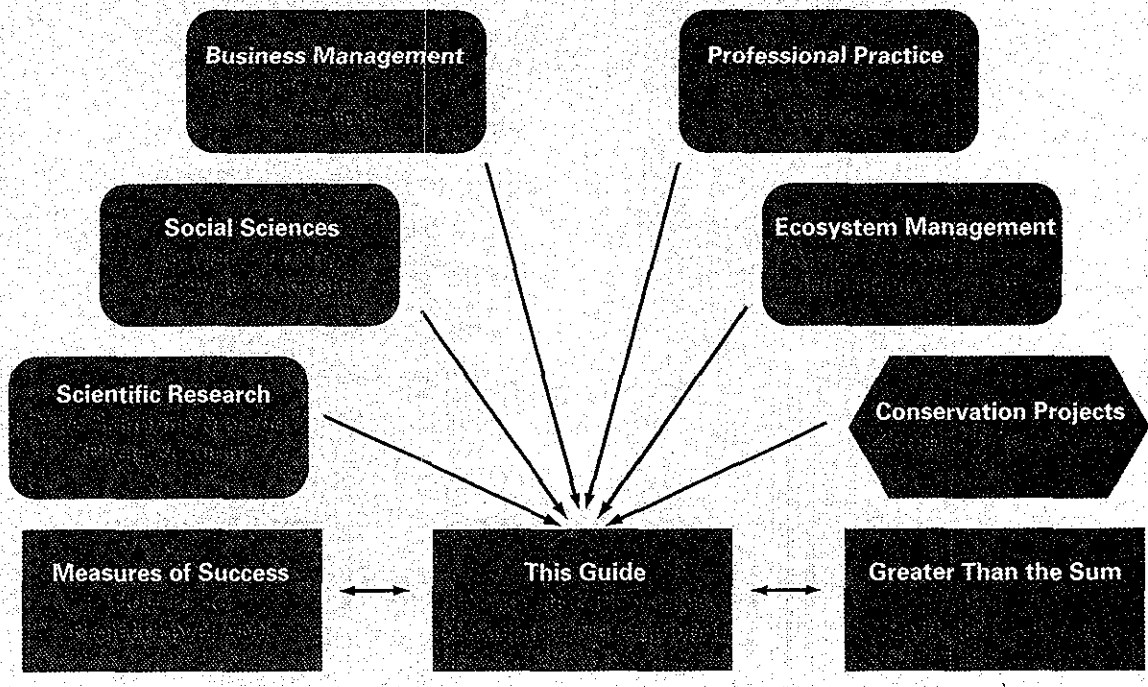
1. **Clearly define what adaptive management is — and what it isn't.**
2. **Describe the conditions that warrant using an adaptive management approach.**
3. **Review the conceptual roots of adaptive management and demonstrate how they are relevant to conservation projects.**
4. **Learn how some field projects are currently doing certain aspects of adaptive management.**
5. **Outline the steps involved in doing adaptive management in conservation projects.**
6. **Determine principles for doing effective adaptive management in conservation projects.**
7. **Suggest future directions to further refine our understanding of adaptive management and its application to conservation projects.**

What Did We Do?

Adaptive management is rooted in many different disciplines, but has not yet been widely used in conservation projects. To address many of the conceptual issues in our objectives, we had to rely heavily on research, analysis, and publications from other fields. Furthermore, to address many of the practical and applied issues in our objectives, we had to locate conservation projects that were practicing some aspects of adaptive management. We also drew on our own experiences in applying adaptive management to projects and portfolios. As shown in Figure 1, this guide synthesizes ideas from a literature review of other fields that have used similar theoretical

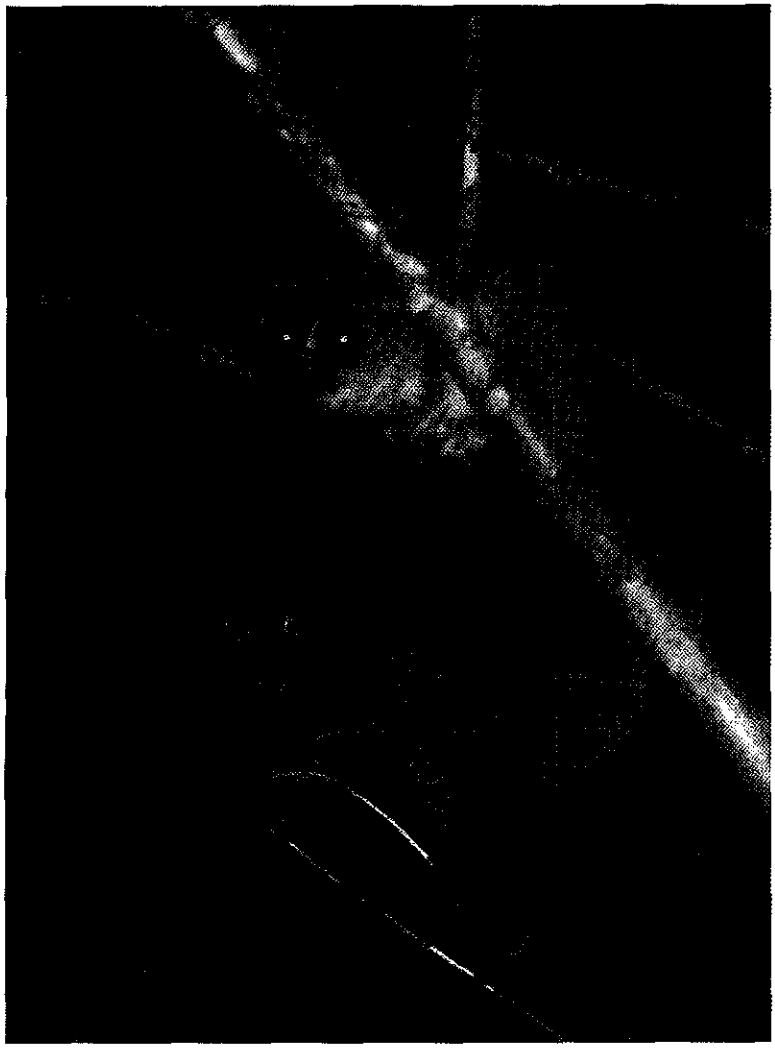
concepts, experiences from conservation projects that have applied at least some of these concepts, and processes from two other publications that we have written. Our research for this guide was divided into three parts:

FIGURE 1.
The Position of This Guide Relative to Existing Works



Reviewing the literature. We canvassed a broad spectrum of fields that have either used adaptive management, or have developed parallel concepts. These fields include science and philosophy, social science, business management, professional practice, and ecosystem management. After reading broadly in each field, we selected one or two sources that we believed best summarized the field. These sources are described in the following section. From this literature review, we developed a draft framework that includes a definition of adaptive management, the conditions that warrant an adaptive management approach, and the steps and principles involved in doing effective adaptive management of conservation projects.

Conducting site visits and key informant interviews. Using this draft framework, we developed a topic guide that we could use to interview key informants in conservation projects from around the world. After a careful search, we selected three projects that we believed clearly demonstrated some of the characteristics of adaptive management that we identified during the literature review. These projects, which are described the following section, include the ADMADE Project in Zambia, the Crater Mountain Project in Papua New Guinea, and the British Columbia Forest Service's Adaptive Management Initiative in Canada. We visited these sites in 1999 and 2000 and interviewed key informants using our topic guide. Most conversations were tape recorded so that we could use transcripts for our analysis.



Developing "how-to" guidebooks. While we were doing the literature review and site-based research, we also developed two "how-to" guidebooks designed to help conservation practitioners apply adaptive management principles to their work. *Measures of Success* is about using adaptive management at a project level. [1] It forms the basis for the steps discussed in the third section of this guide. *Greater Than the Sum of Their Parts* is about using adaptive management across multiple projects in a portfolio. [2] It forms the basis for the steps discussed in the last section of this guide.

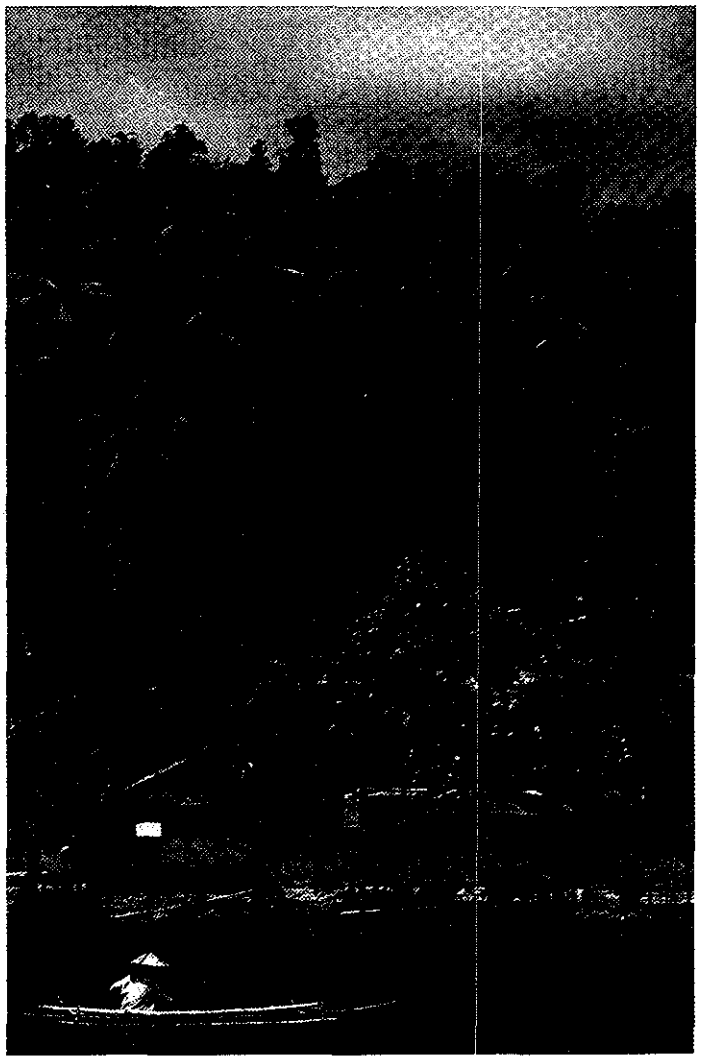
Based on the results of these three activities, we developed the final framework described in this guide.

Some Things to Keep in Mind

As you read through this publication, please keep in mind the following points:

Our work is descriptive and synthetic. To come up with the principles we include in this publication, we did not use a random sample of projects or a systematic experimental design. Instead, we were much more opportunistic and used the insights and experience of other fields and examples of conservation projects that exhibit some characteristics of adaptive management. We wrote this publication in an attempt to capture and synthesize relevant state-of-the-art thinking on and application of adaptive management.

This is not a "how-to" guide. This publication does not explain in detail the process for doing adaptive management. As you read this publication, we hope you will think about your own experiences and how you might apply the steps and principles we present. If you are interested in learning more about adaptive



management as an idea, you can then go on to read the original sources that we used as well as the other sources listed in the references section. If you are interested in trying an adaptive management approach with your project, we recommend taking a look at *Measures of Success,* which describes in greater detail the steps involved in designing, managing, and monitoring conservation projects. If you are interested in trying an adaptive management approach with a portfolio of projects, we suggest consulting *Greater Than the Sum of Their Parts,* which describes similar steps at a program level.

This is an intermediate step. We did not write this guide to be the last word on adaptive management and its application to conservation projects. Instead, we expressly set out to provide an intermediate step that clarifies the current state of knowledge as to what adaptive management is and how conservation practitioners might better apply it to their work. We hope that this guide serves as a catalyst that will lead to an improved understanding over time of how to use adaptive management to more efficiently reach conservation goals and build learning organizations.

AN INTRODUCTION TO ADAPTIVE MANAGEMENT

IN THIS SECTION, we first define adaptive management. We then outline some of the conditions that warrant taking an adaptive management approach in conservation projects.

What Is Adaptive Management?

Adaptive management is a relatively new concept — one that has only recently begun to gain popularity in the mainstream conservation community. But what is it? Some people may ask, "Isn't adaptive management simply good management? Doesn't it merely involve trying something and then if it doesn't work, using your common sense to adapt and try something else?" We believe that adaptive management is good management, but that not all good management is adaptive management. We also believe that adaptive management requires common sense, but that it is not a license to just try whatever you want. Instead, adaptive management requires an explicitly experimental — or "scientific" — approach to managing conservation projects as outlined in the following definition:

Adaptive management incorporates research into conservation action. Specifically, it is the integration of design, management, and monitoring to systematically test assumptions in order to adapt and learn.

This definition can be expanded as follows:

a) Testing assumptions is about systematically trying different actions to achieve a desired outcome. It is not, however, a random trial-and-error process. Instead, it involves first thinking about the situation at your project site, developing a specific set of assumptions about what is occurring and what actions you might be able to use to affect these events. You then implement these actions and monitor the actual results to see how they compare to the ones predicted by your assumptions. The key here is to develop an understanding of not only which actions work and which do not, but also why.

b) Adaptation is about taking action to improve your project based on the results of your monitoring. If your project's actions did not achieve the expected results, it is because either your assumptions were wrong, your actions were poorly executed, the conditions at the project site have changed, your monitoring was faulty — or some combination of these problems. Adaptation involves changing your assumptions and your interventions to respond to the new information obtained through monitoring efforts.

c) Learning is about systematically documenting the process that your team has gone through and the results you have achieved. This documentation will help your team avoid making the same mistakes in the future. Furthermore, it will enable other people in the broader conservation community to benefit from your experiences. Other practitioners are eager to learn from your successes and failures so that they can design and manage better projects and avoid some of the hazards and perils you may have encountered. By sharing the information that you have learned from your project, you will help conservation efforts around the world.

Our definition of adaptive management includes a framework of specific *conditions* that warrant an adaptive management approach, *steps* for the process of adaptive management, and *principles* for the practice of adaptive management. This framework, which is described in the remainder of this guide, is summarized in the box on the next page.

Summary of the Framework for Adaptive Management Presented in This Guide

Definition of Adaptive Management

Adaptive management incorporates research into conservation action. Specifically, it is the integration of design, management, and monitoring to systematically test assumptions in order to adapt and learn.

Conditions That Warrant an Adaptive Management Approach

Condition 1: Conservation Projects Take Place In Complex Systems

Condition 2: The World Is a Constantly and Unpredictably Changing Place

Condition 3: Our "Competitors" Are Changing and Adapting

Condition 4: Immediate Action Is Required

Condition 5: There Is No Such Thing as Complete Information

Condition 6: We Can Learn and Improve

Steps in the Process of Adaptive Management

START: Establish a Clear and Common Purpose

STEP A: Design an Explicit Model of Your System

STEP B: Develop a Management Plan That Maximizes Results and Learning

STEP C: Develop a Monitoring Plan to Test Your Assumptions

STEP D: Implement Your Management and Monitoring Plans

STEP E: Analyze Data and Communicate Results

ITERATE: Use Results to Adapt and Learn

Principles for the Practice of Adaptive Management

Principle 1: Do Adaptive Management Yourself

Principle 2: Promote Institutional Curiosity and Innovation

Principle 3: Value Failures

Principle 4: Expect Surprise and Capitalize on Crisis

Principle 5: Encourage Personal Growth

Principle 6: Create Learning Organizations and Partnerships

Principle 7: Contribute to Global Learning

Principle 8: Practice the Art of Adaptive Management

Conditions That Warrant an Adaptive Management Approach

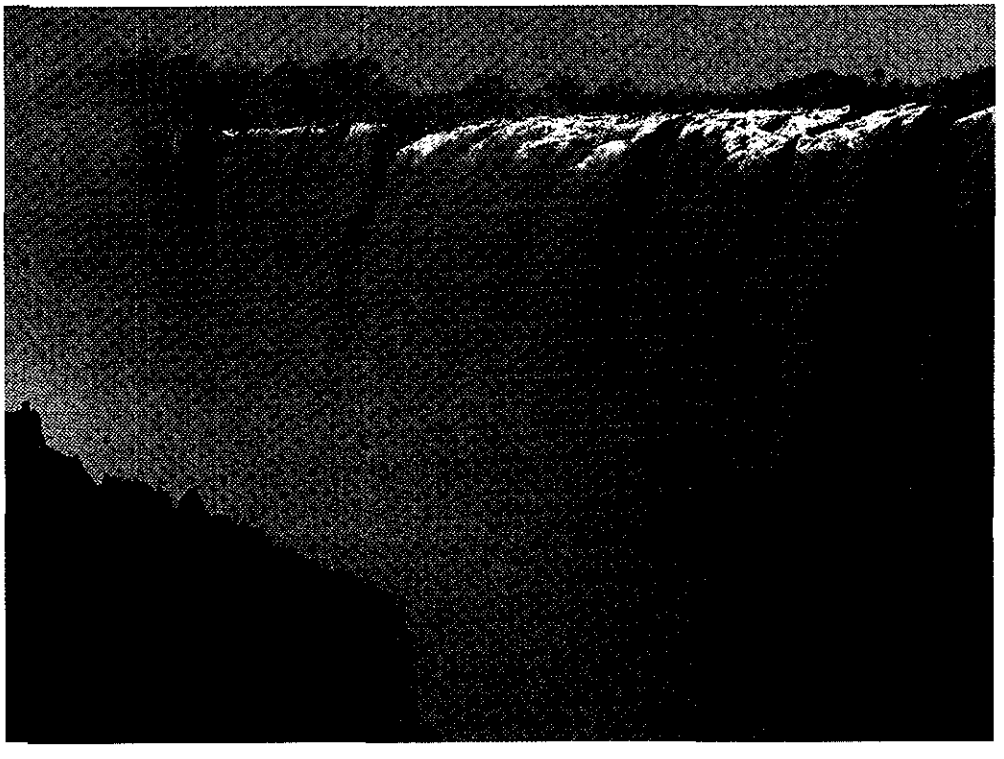
Adaptive management is driven by the serious challenges that all conservation practitioners face. It has been developed to help conservation project managers make sense of seemingly confusing and chaotic situations that they face on a daily basis, and to provide a framework to learn systematically from their successes and failures as well as those of others. In this section we describe some of the most prevalent conditions encountered by many project managers as they attempt to achieve their goals and objectives — conditions that necessitate an adaptive management approach to conservation project management.

Condition 1: Conservation Projects Take Place in Complex Systems

Conservation practitioners need to deal with a wide range of factors and circumstances as they implement and manage field projects. At any given site, there are dozens if not hundreds of factors that influence the status of biodiversity and its conservation. There are geophysical factors like climate, weather, winds and currents, and soils. There are ecological factors like regeneration rates and predator-prey interactions. There are social factors like culture, demographic and family structures, and religion. There are political factors like the type of government and the willingness of national governments to address local problems. There are economic factors like cash needs, employment opportunities, exchange rates, and markets. There are institutional factors like the strength of leadership in project organizations and the ability of project team members to work together. And there are random factors like diseases, economic crashes, or earthquakes and volcanoes that can completely destroy projects. It is not an exaggeration to say that conservation projects take place in perhaps some of the most complex systems that humans have ever dealt with.

Condition 2: The World Is a Constantly and Unpredictably Changing Place

This complex world in which conservation projects take place is also constantly changing. It is generally fairly easy for humans to adapt to predictable change in the natural world like the rising and setting of the sun, the cycles of the tides, and the seasonality of snows or monsoon rains. Other sorts of natural change, like Pleistocene



glaciation and deglaciation, though less predictable, occur over time scales longer than the attention span of humans. Whereas these changes may have affected our evolution, they do not exist in our conscious minds. Change, of course, affects not only the natural world, but the human one as well. Changes in life expectancies, market expectations, political systems, and human hopes all can impact conservation projects, which historically have been ill equipped to adapt to a changing world. Furthermore, not all change is linear and predictable. Volcanoes, El Niño, plant epidemics like the Irish potato famine fungus, and alternate stable states in ecological systems all represent the types of change that prove difficult for humans to control or understand. Yet these types of change are pervasive in the natural world and even more common in the world of human affairs where economic crashes or political coups can almost overnight radically alter the landscape in which project teams must operate. The existence of change of any sort, let alone non-linear change, makes adaptability an essential element of conservation projects. Surprise does not always have to be an enemy; it can also be an ally if you know how to turn it into an opportunity to accomplish your goals.

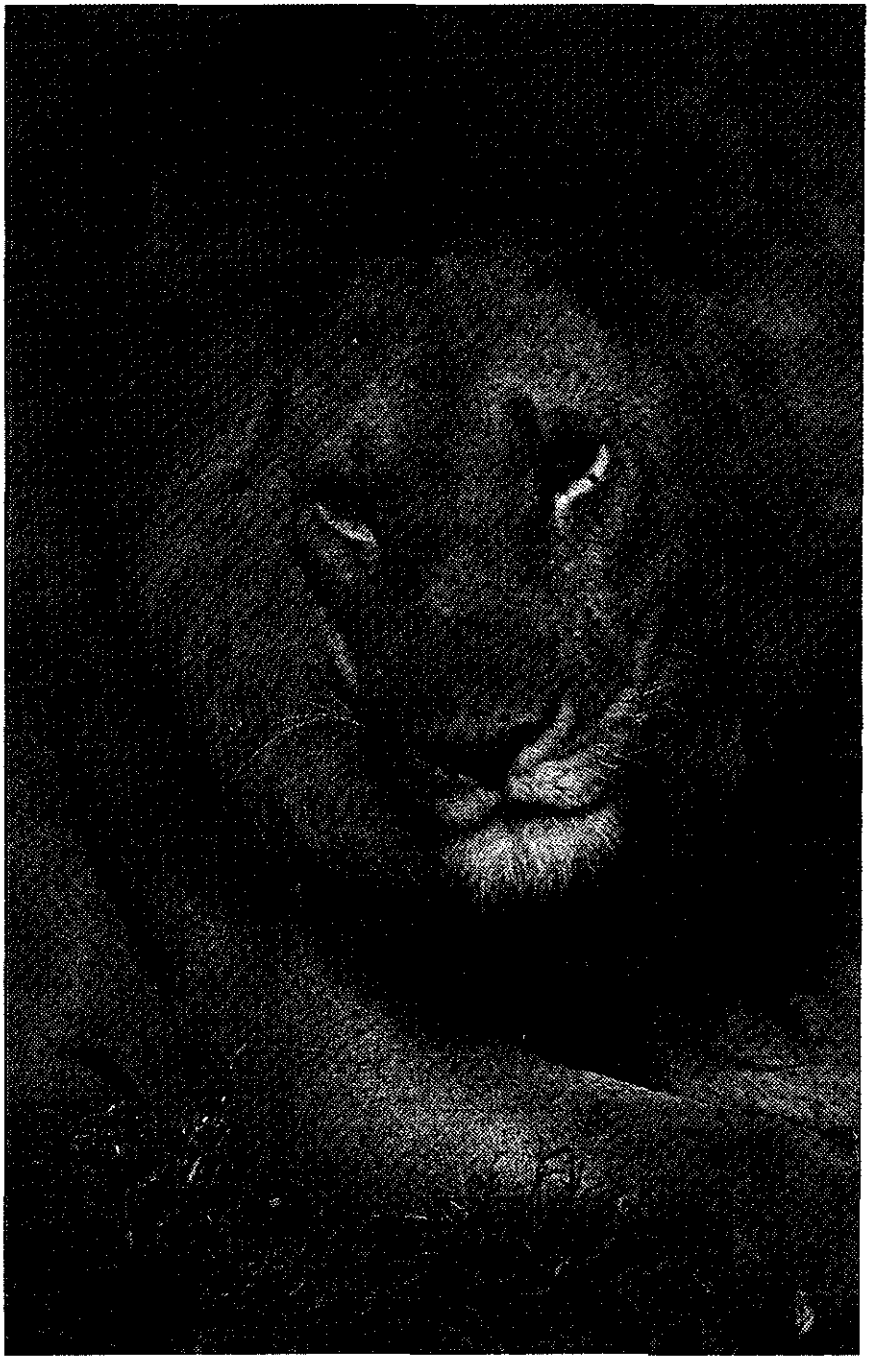
Condition 3: Our "Competitors" Are Changing and Adapting

The need to stay one step ahead of the competition is clearly evident in the world of conservation projects. Logging firms change and adopt new tactics. Poachers use new traps. Commercial land developers are forever finding ways of getting around zoning laws. Big business, like sugar producers or oil companies, manipulate public opinion by changing public image through the use of expensive advertising. It's a battle. The conservation community — including conservation practitioners and managers — must adapt to compete. Unfortunately, with rare exceptions, conservation projects are most often managed by governmental agencies or non-governmental organizations (NGOs) that have far fewer financial and human capital resources than their competitors. As a result, project teams have to be "smarter" in order to succeed and get the most out of the resources that they have. Organizations, like human beings, can often survive by sticking to one strategy or by changing through a trial-and-error process. However, those organizations that are most strategic and can adapt the best and most efficiently have the greatest chance of thriving and getting and staying ahead of the competition.

Condition 4: Immediate Action Is Required

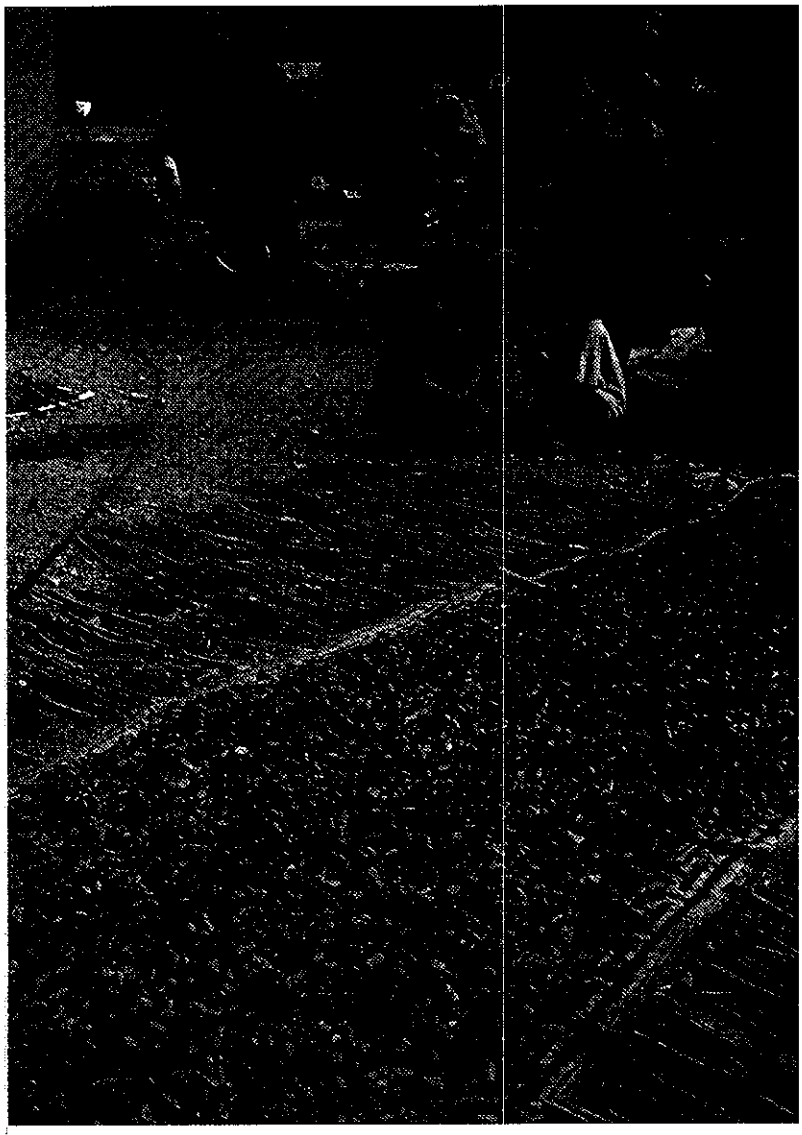
Despite the constantly and usually unpredictably changing world and despite incomplete information, we must never stop conserving biodiversity and managing resources. This is because humans will never stop our seemingly inexorable consumption of the earth's biosphere and geosphere. Fishers will not stop fishing, loggers will not stop logging, and human populations will not stop growing in size and resource consumption. Therefore, conservation projects helping park directors, resource managers, and community conservation groups cannot flag in their efforts. To stop is to surrender.

Condition 5: There Is No Such Thing as Complete Information



The success of humans has, in large part, been possible due to our abilities to gather and interpret information. In early millennia it was information derived from animal tracks and smoke signals, whereas, we are now using satellite-based cameras and the Internet. In many parts of our lives, particularly personal ones, we are used to operating with less than complete information. Despite this, we typically expect assurance that conservation or development decisions will be based on complete information. Unfortunately, measuring and fully understanding biodiversity at a given site is a difficult, if not impossible, undertaking. Likewise, social, economic, and political information related to human populations living in or around the area of concern is rarely complete. As a result, complete knowledge cannot be a necessary pre-condition to design and implement conservation policies or activities. Conservation practitioners do not have the luxury to wait until all the biological, ecological, and social characteristics of a given area are known and understood before they implement project activities. Most often, they

must act using only existing information — and they must act quickly to counter some pressing threat. Incomplete knowledge of biological and social conditions should not be a barrier to action, but should be used as efficiently and wisely as possible to design effective interventions. Important gaps in knowledge must be identified and addressed early in the conservation project in order to make the best decisions throughout the life of the project.

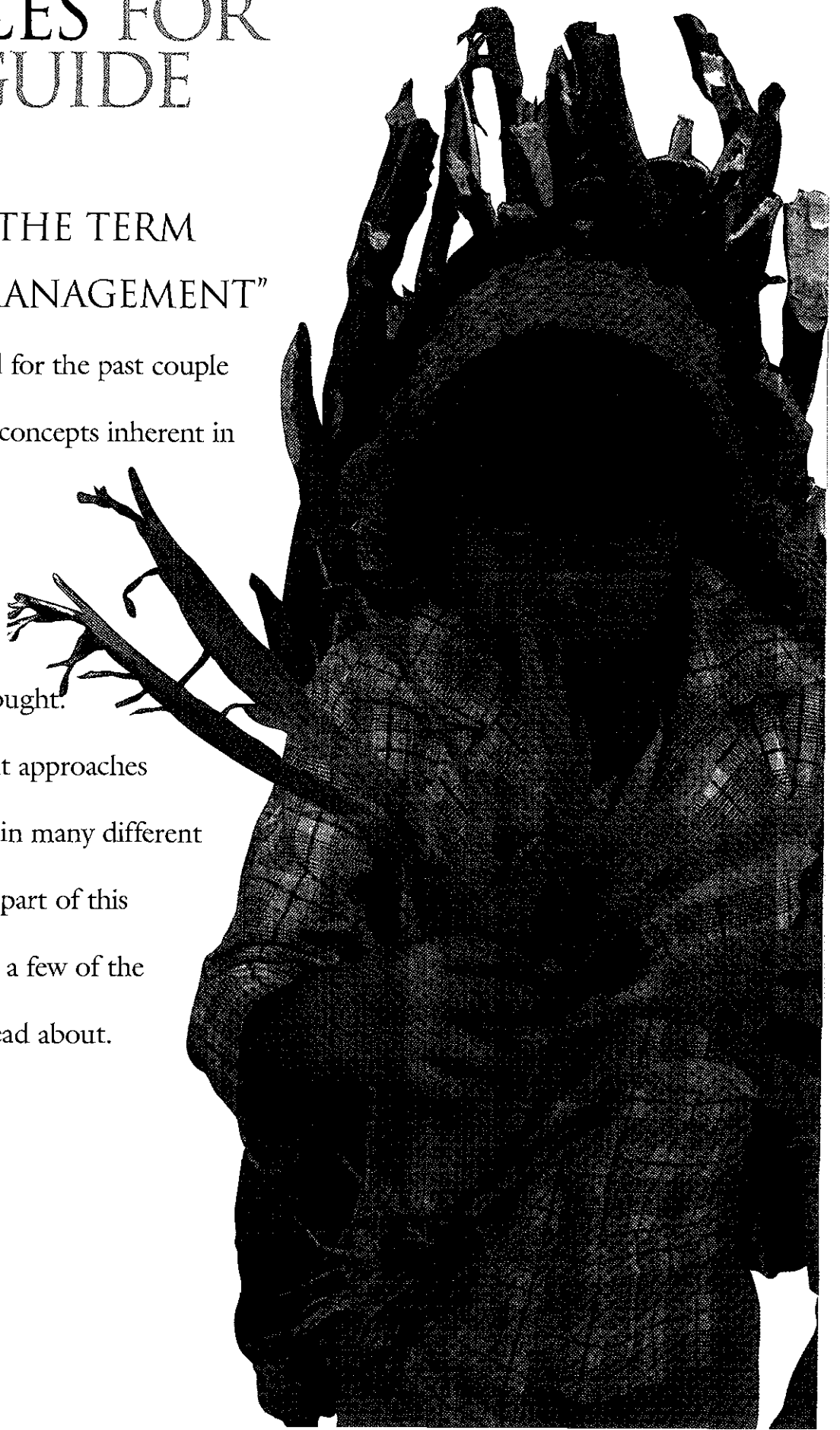


Condition 6: We Can Learn and Improve

Against the prospect of continuing change, human consumption, and habitat alteration is the proven fact that humans can and have improved their ways of living lightly on the earth. The challenge is to stimulate novelty, build in flexibility, adaptability and learning, and help conserve the remains of the biodiversity left in an already heavily influenced world. Success will ultimately only happen to the degree to which we can learn and use what we have learned to improve our conservation efforts.

SOURCES FOR THIS GUIDE

ALTHOUGH THE TERM "ADAPTIVE MANAGEMENT" has only been around for the past couple of decades, the basic concepts inherent in this term have been expressed for centuries in various schools of human thought. Adaptive management approaches have been developed in many different contexts. In the first part of this section, we introduce a few of the approaches that we read about.



Specific fields that we consulted include:

- Science and Philosophy — "The Scientific Method"
- Social Sciences — "Social Learning"
- Business Management — "The Learning Organization"
- Professional Practice — "Reflection-in-Action"
- Ecosystem Management — "Adaptive Management"

Elements of adaptive management have also been adopted by many conservation and natural resource management projects. In the second part of this section, we describe the projects in the three countries that we visited:

- Zambia — The ADMADE, KANTIPO, and SLAMU Projects
- Canada — The British Columbia Forest Service's Adaptive Management Initiative
- Papua New Guinea — The Research and Conservation Foundation's Crater Mountain Project

Each of these sources contributed to the framework for effective adaptive management presented in this guide.

Literature We Reviewed

The Scientific Method

The most basic concepts behind all adaptive management approaches can be found in the traditions of science and philosophy. In the Western tradition, these advances are embodied in the development of the formal scientific method. The scientific method has its roots in the work of the ancient Greek philosophers such as Democritus, Socrates, Plato, and Aristotle who developed the first formal elements of logic and reason. This work was then further refined through the work of subsequent philosophers like Aquinas, Descartes, Hume, and Kant, and scientists like Galileo, Newton, Pasteur, Darwin, and Einstein. To represent the "scientific method," we use some of the ideas outlined by Robert Pirsig in his book *Zen and the Art of Motorcycle Maintenance.* We also briefly touch on a few concepts advocated by Thomas Kuhn in his book *The Structure of Scientific Revolutions* and the idea of "post-normal" science represented by the works of Silvio Funtowicz and Jerome Ravetz. [3]

Conditions That Warrant Using the Scientific Method

According to Pirsig, at it's most basic sensory level, the universe is "unintelligible, just a kaleidoscopic jumble of colors and patterns and noises and smells and pain and tastes without meaning." [4] Pirsig is interested in how humans have used the scientific method to organize our collective understanding of these pure sensory data into a pyramid of knowledge about the universe. Pirsig describes the formal scientific method in comparison to informal ways of acquiring knowledge as "a huge bulldozer — slow, tedious, lumbering, laborious, but invincible...it takes twice as long, five times as long, maybe a dozen times as long as informal techniques, but you know in the end you're going to *get* it." [5] This formal process is needed because in scientific work "otherwise the problems get so complex that you get lost in them and confused and forget what you know and what you don't know and have to give up." [6]

A Brief Description of the Scientific Method

Pirsig describes how at its core, the scientific method involves weaving together two kinds of logic. *Inductive inference* involves starting with observations of the natural world and then arriving at general conclusions based on these observations. Induction is thus reasoning from particular experience to general truths. *Deductive inference* involves starting with general knowledge and predicting specific results. Deduction is thus reasoning from general truths to particular experience. The scientific method involves combining long strings of mixed inductive and deductive inferences. [7]

To be truly effective, the use of inductive and deductive reasoning has to be done very systematically so that as you add to the pyramid of knowledge, you avoid making any errors on lower levels that could cause the entire structure to come crashing down. The formal scientific method involves eight steps: 1) State the problem that you would like to change, 2) Develop a hypothesis as to the cause of the problem, 3) Design an experiment to test the hypothesis, 4) Predict what you think will happen when you undertake the experiment, 5) Implement the experiment following the protocol that you outlined, 6) Describe the results of the experiment focusing only on

what you have observed and not make any unwarranted inferences, 7) Analyze and draw conclusions from the results of the experiment without concluding more than you have proved, and 8) Publish the results of your experiment so that other people can learn from your findings and will not have to "reinvent the wheel." [8]

Kuhn looks at the larger scale of how science operates in general. He defines the collection of knowledge and models in any given field as a *paradigm.* Kuhn argues that the development of paradigms is not a gradual process, but occurs in a series of waves in which the greatest advances take place during crisis periods when existing theory and the normal modes of scientific inquiry break down. Funtowicz and Ravetz extend this concept, arguing that when dealing with large complex problems like environmental issues, the traditional scientific method cannot be used successfully in the face of high stakes, a high degree of uncertainty, and conflicting values held by different stakeholders. Instead, they advocate using science in a way in which it is "no longer imagined as delivering truth" and instead, decision-making becomes a mutual learning process among different stakeholders. [9]

Social Learning

Practitioners in a number of different fields began to take the scientific method and apply it to problems that they were facing, seeking to turn knowledge into action. One of the earliest of these efforts was in the social sciences where practitioners were concerned with the question of how groups make decisions. This work began to become known as social learning. Social learning can in part be traced from John Dewey's philosophy of pragmatism — a theory of getting things done. [10] For Dewey, learning comes from the interplay between practice and planning and then back to practice:

> *The plans which are formed...as guides of reconstructive action, are not dogmas. They are hypotheses to be worked out in practice, and to be rejected, corrected, and expanded as they fail or succeed in giving our present experience the guidance it requires.* [11]

Dewey's influence was seen in the work of a wide range of people ranging from the planner Lewis Mumford, the economist Edgar J. Dunn, and even Mao Tse-tung whose essay "On Practice" echoes the same thoughts: "Practice, knowledge, again practice, and again knowledge. This form repeats itself in endless cycles, and with each cycle, the content of practice and knowledge rises to a higher level." [12] To represent this work, we look at the field of "social learning" as described by Chris Argyris and Donald Schön in their book *Organizational Learning: A Theory of Action Perspective.*

Conditions That Warrant Social Learning

Argyris and Schön base their work in the need to help organizations function better. According to Argyris and Schön, an organization is a collection of people whose members devise rules for making decisions in the name of the collectivity. [13] The problem is to try to get the organization to capture knowledge generated so that it does not repeat mistakes. As Argyris and Schön put it:

> *Organizational learning is not the same thing as individual learning, even when the individuals who learn are members of the organization. There are too many cases in which organizations know less than their members. There are even cases in which the organization cannot seem to learn what every member knows.* [14]

A Brief Description of Social Learning

Every organization has what Argyris and Schön call a "theory-of-action" that guides what activities the organization chooses to pursue. Unfortunately, an organization's stated theory may often differ from its actual "theory-in-use." As a result, as Argyris and Schön state:

> *Organizational learning occurs when members of the organization act as learning agents for the organization, responding to changes in the internal and external environments of the organization by detecting and correcting errors in organizational theory-in-use, and embedding the results of their inquiry in private images and shared maps of organization...In both cases, organizational learning consists of restructuring organizational theories of action.* [15]

Although these ideas are developed in the context of specific organizations, Argyris and Schön made it clear that the same principles apply to society as a whole.

The Learning Organization

Different schools of thought for managing businesses and organizations have probably been around for as long as there have been businesses — it's not that hard to imagine merchants in ancient Babylon or China talking to one another in their stalls about the latest strategy for maximizing profit flow and avoiding taxes. In the past few decades, however, a number of schools of thought on business and organizational management have developed that have begun to converge on similar ideas. Examples of these different schools include strategic planning, [16] management by objectives/results, [17] total quality management, [18] and structured flexibility. [19] To represent this approach, we focused on the concept of the "learning organization" that is presented in Peter Senge's book *The Fifth Discipline: The Art & Practice of the Learning Organization.*

Conditions That Warrant Learning Organizations

For Senge, the key condition is that managers are working with systems. A system is a series of interconnected factors that affect one another. Because managers are working with systems, they cannot merely focus on part of the system, but instead need to use systems thinking. As Senge writes: "Systems thinking is a discipline for seeing wholes. It is a framework for seeing interrelationships rather than things, for seeing patterns of change rather than static snapshots." [20] For Senge, "Today, this systems thinking is important because we are being

overwhelmed by complexity. Perhaps for the first time in history, humankind has the capacity to create far more information than we can absorb...and to accelerate change far faster than anyone's ability to keep pace." [21] Furthermore, this complexity is not in the sheer numbers of variables in the system — the *detail complexity* of the system — but also in the ways in which these variables interact with one another — the *dynamic complexity* of the system. [22] The complexity of these systems means that those corporations that can deal with it best will be the most likely to survive.

A Brief Description of Learning Organizations

Senge's approach to developing a learning organization involves mastering five different disciplines. For Senge, the key discipline is *systems thinking*. One of the main tenets of systems thinking is that all systems have an inherent structure that can dictate outcomes and behaviors. In most systems, these factors are not linearly related, but instead linked in webs or loops with different factors interacting with each other in different ways. As a result, many well-intentioned efforts to solve problems by focusing on only part of the system can have unintended results. At the same time, however, small, well-focused actions can sometimes produce significant, enduring improvements, if they're in the right place. Senge refers to this principle as "leverage." Senge's other disciplines include developing *mental models* of the system in question, building *shared visions* of the future that you seek to create, enhancing *team learning*, and promoting *personal mastery* that involves a commitment to lifelong learning. [23]

Reflection-in-Action

Another offshoot of the social learning and organizational development work is related to the work done by professionals — practitioners of fields like medicine, law, architecture, and planning. These professions have a scientific underpinning of *technical rationality* that can be traced back to the work of the French philosopher August Comte in the early 1800s. The expansion of technical rationality into all fields continued throughout the 19th and 20th centuries, peaking in World War II with the development of the field of operations research, which used scientific approaches to track submarines and build nuclear weapons. These successes led to a growing sense that all problems conld be dealt with through the rigorous application of the scientific method. In the 1960s, however, as researchers began to apply technical rationality with little or no success to social and political problems, doubts began to creep in about the validity of the approach. A growing movement developed to look at how to best help professionals deal with the difficult problems that they are facing. To represent this movement, we use the ideas outlined by Donald Schön in his book *The Reflective Practitioner*, which describes the process he terms "reflection-in-action."

Conditions That Warrant Reflection-in-Action

Schön starts by looking at the types of problems that professionals work with. He finds that the hallmark of these problems is that they are complex, uncertain, unstable, unique, and laden with value conflicts. Whereas traditional academics deal with relatively tidy and clean problems that can be solved through rigorous

application of technical knowledge, practitioners are faced by these messy problems that are more relevant to the real world, but that resist traditional technical based approaches. As Schön states:

> *In the varied topography of professional practice, there is a high, hard ground where practitioners can make effective use of research-based theory and technique, and there is a swampy lowland where situations are confusing "messes" incapable of technical solution. The difficulty is that the problems of the high ground, however great their technical interest, are often relatively unimportant to clients or to the large society, while in the swamp are the problems of greatest human concern. Shall the practitioner stay on the high, hard ground where he can practice rigorously, as he understands rigor, but where he is constrained to deal with problems of relatively little social importance? Or shall he descend to the swamp where he can engage the most important and challenging problems if he is willing to forsake technical rigor?...There are those who choose the swampy lowlands. They deliberately involve themselves in messy, but crucially important problems and, when asked to describe their methods of inquiry, they speak of experience, trial and error, intuition, and muddling through.* [24]

A Brief Description of Reflection-in-Action

Reflection-in-Action is a process that begins by "setting the problem" and "framing the context" in which the problem will be dealt with. [25] Next, the practitioner sets up experiments that test his or her understanding of the situation. These experiments take place in the context of everyday practice. As Schön writes, the practitioner "becomes a researcher in the practice context...he does not keep means and ends separate, but...implementation is built into inquiry. Thus reflection-in-action can proceed, even in situations of uncertainty, or uniqueness." [26] Schön pointed out that the practitioner's experimentation is different from that of the traditional scientist:

> *The practice context is different from the research context in several important ways, all of which have to do with the relationship between changing things and understanding them. The practitioner has an interest in transforming the situation from what it is to something he likes better. He also has an interest in understanding the situation, but it is in the service of his interest in change.* [27]

Adaptive Management of Ecosystems and Natural Resources

In North America, the first few hundred years after Columbus landed saw little or no management of natural resources, especially at ecosystem levels. [28] The basic principle behind the "frontier mentality" was to harvest what you could as fast as technically and economically possible and then, when the returns began to diminish, move on to new locations. In the late 1800s, however, the obvious shortsightedness of this approach started to become apparent with the close of the frontier. A number of visionary thinkers such as John Muir, Gifford Pinchot and Theodore Roosevelt began to realize that it would become important to manage these resources. This realization led to the development of federal, state, and local government agencies and non-government organizations, all of which were concerned with managing natural resources. During much of the following century, the natural resource management that these agencies and organizations promoted was primarily reactive and focused on discrete elements of the overall system. Under this "command and control" approach, a manager was trained to focus on a specific target variable.

In the early 1970s, policy makers and resource managers became dissatisfied with the traditional procedures and principles of resource management and sought some realistic alternatives. In response, a group of scientists led by C.S. Holling and Carl Walters began to argue for a new approach to these problems that might address some of these concerns. These ideas were developed in the context of resources drawn from large ecosystems like salmon along the Northwest Coast of North America, timber in the Canadian forests, and fresh water in the Florida Everglades. The approach was first termed "adaptive environmental assessment and management" and was then later shortened to "adaptive management." To represent this work, we use the ideas outlined by Kai Lee in his book *Compass and Gyroscope: Integrating Science and Politics for the Environment* and C.S. Holling in his introduction to the book *Barriers and Bridges to the Renewal of Ecosystems and Institutions.*

Conditions That Warrant an Adaptive Management Approach

Holling and his co-workers outline a number of conditions of ecosystems that warrant taking an adaptive management approach as opposed to the traditional command and control approach: 1) ecosystems are complex, but everything is not strongly connected to everything else, 2) ecosystems are non-uniform over space and time, 3) the unexpected can be expected, and 4) eliminating change does not lead to environmental quality. [29] In addition to these conditions about the nature of ecosystems, there are also conditions about the limited ability of a researcher or manager to understand the ecosystem that favor an adaptive management approach. As Lee states: 1) data are sparse because it is difficult to observe the state of the ecological system and the human economy interacting with it, 2) theory is limited and does not permit deductive logic to extrapolate very far from experience, and 3) surprise is unexceptional so that predictions are often wrong, expectations unfulfilled, and warnings hollow. [30]

A Brief Description of Adaptive Management of Ecosystems

An adaptive management approach deals with the uncertainty inherent in managing natural ecosystems by treating policies as experiments. As Lee puts it:

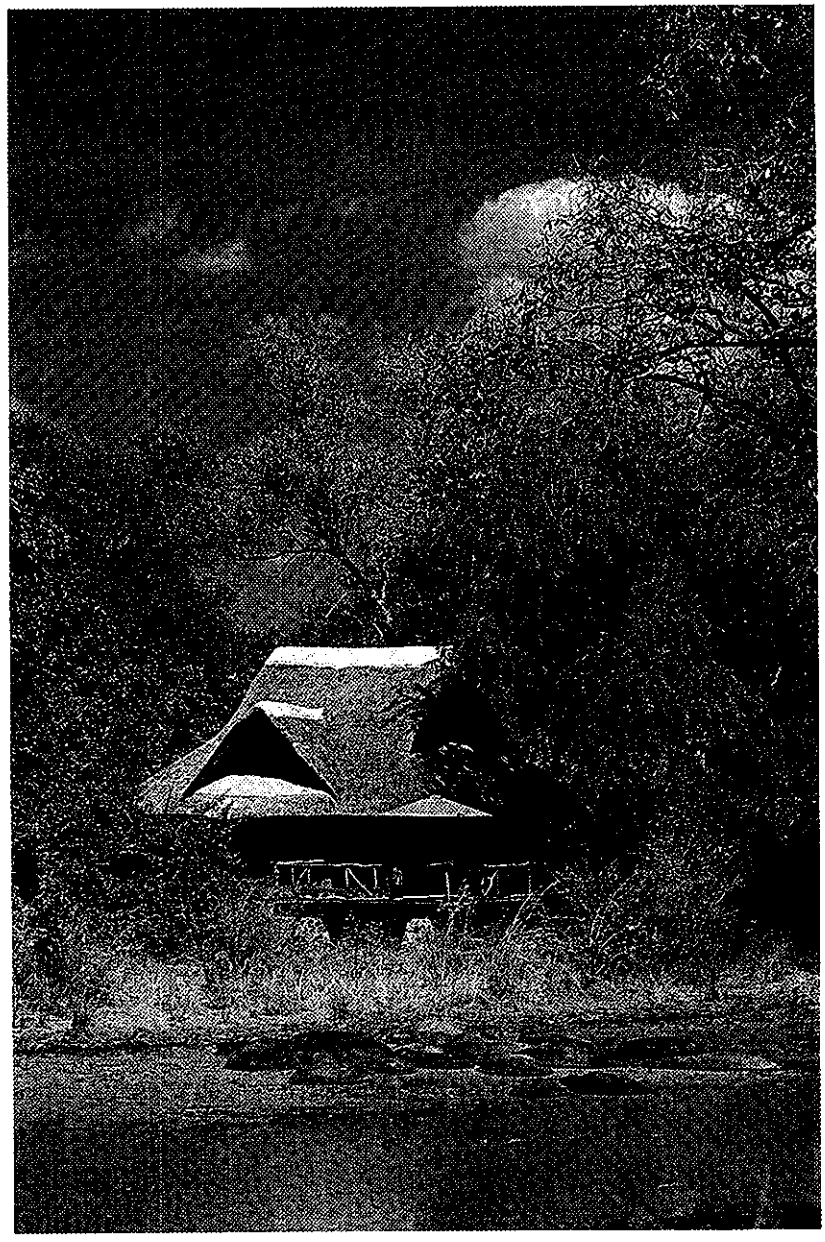
> *Adaptive management is an approach to natural resource policy that embodies a simple imperative: polices are experiments; learn from them...Adaptive management takes uncertainty seriously, treating human interventions in natural ecosystems as experimental probes. Its practitioners take special care with information. First, they are explicit about what they expect, so that they can design methods and apparatus to make measurements. Second, they collect and analyze information so that expectations can be compared with actuality. Finally, they transform comparison into learning — they correct errors, improve their imperfect understanding, and change action and plans. Linking science and human purpose, adaptive management serves as a compass for us to use in searching for a sustainable future.* [31]

Projects We Visited

Community-Based Wildlife Management in Zambia

During our field visit to Zambia we focused primarily on the Administration Management Design (ADMADE) project. We interviewed Gilson Kaweche, then Director of National Parks and Wildlife Service at its headquarters in Lusaka. While at ADMADE's headquarters of operations at the Nyamaluma Training Institute in Lupande, we interviewed Dale Lewis, Technical Advisor, and many of the staff who manage ADMADE (For more information on ADMADE, go to **www.ADMADE.org**).

During our visit to Zambia, we also spoke to representatives of the Kafue Anti-Poaching (KANTIPO) project based in Kafue National Park, and the South Luangwa Area Management Unit (SLAMU) project based outside of the South Luangwa National Park. We interviewed Stephan Forster, General Manager of KANTIPO, and Brian Child, Technical Advisor to SLAMU Project Manager.



Conditions That Warrant an Adaptive Management Approach

Zambia is a country rich in wildlife. But in recent times, wildlife numbers have declined precipitously as rural populations have grown, hunting has intensified, and encroachment into national parks has increased. Because of a lack of financing and infrastructure, the Government of Zambia has been hard-pressed to control the internal and external threats to its wildlife. In response to these threats, the Government of Zambia has developed a decentralized approach to natural resource management in which control over wildlife in designated

Game Management Areas is given primarily to local communities. In this way, subsistence hunting is monitored, poaching by outside forces is tightly controlled, and many of the benefits of commercial safari hunting flow directly to the communities.

Growing out of a workshop that occurred in Lupande in 1983, the Zambian National Parks and Wildlife Service established the ADMADE program. ADMADE is Zambia's official community-based natural resource management initiative and is responsible for working in 36 Game Management Areas throughout the country. ADMADE works with communities through Community Resource Boards, which are elected by community members. Working with the Government and private sector investors — such as tour and commercial safari operators — the Community Resource Boards are empowered to make most of the natural resource management decisions in their local area.

ADMADE works to find ways in which communities can manage their wildlife resources sustainably. Many of the projects supported by ADMADE are designed to promote community development as a way of offsetting threats to biodiversity. The major source of revenue for many ADMADE communities is commercial safari hunting — safari clients often pay as much as $1300 to $1500 per day for the privilege of hunting in the Game Management Areas of Zambia.

At the Nyamaluma Training Institute, ADMADE trains village scouts, unit leaders, bookkeepers, enumerators, and data analysts. It also conducts seminars and workshops for village chiefs, the Community Resource Board members, and other community leaders. It also monitors all aspects of ADMADE operations including results of scouting patrols, training, community development, and commercial safaris.

KANTIPO, the second organization we visited, is managed by a board of directors and steered by an association of stakeholders including tour and safari operators, lodge owners, National Parks and Wildlife Service, and local communities. KANTIPO primarily supports the activities of anti-poaching units in Kafue and also works with local communities to find incentives to counteract hunting activities.

SLAMU, the third group we visited, works in the Luangwa area, controlling the South Luangwa National Park and the Upper and Lower Lupande Game Management Areas. Like ADMADE, SLAMU is a community-based natural resource management project.

Elements of Adaptive Management in These Projects

According to Dale Lewis, "ADMADE is a continually evolving program that actively applies the principles of adaptive management to identify, test, and refine methodologies that support community-based natural resource management." [32] ADMADE monitors wildlife throughout the project area primarily through village scouts. These scouts accompany safari operators to collect hunting data and ensure that they follow the rules. Data collected through these efforts are used to ensure that proper fees are paid to the Government of Zambia and local communities. They are also used to continually adjust hunting quotas. The scouts also conduct regular patrols and collect data on poaching, illegal fish camps, and encroachment into the national parks. ADMADE has been

careful to understand the local conditions that drive overhunting in the GMAs. It has invested considerably in data collection and analysis, and according to Dale Lewis, "From such analysis, additional questions can be asked as to how best adapt ADMADE to these variables in achieving biodiversity conservation, supporting community development needs, and promoting private sector profits." [33]

The other two projects we visited also demonstrate characteristics of adaptive management approaches. KANTIPO utilizes a very systematic approach to determining threats, identifying strategic issues to address, developing objectives, planning activities, and monitoring results. The foundation of all of this work is a project "cause-effect" model in which project managers analyze the core problems affecting the Kafue National Park. The SLAMU project staff have made considerable investments in problem analysis, goal setting, and data collection and analysis.

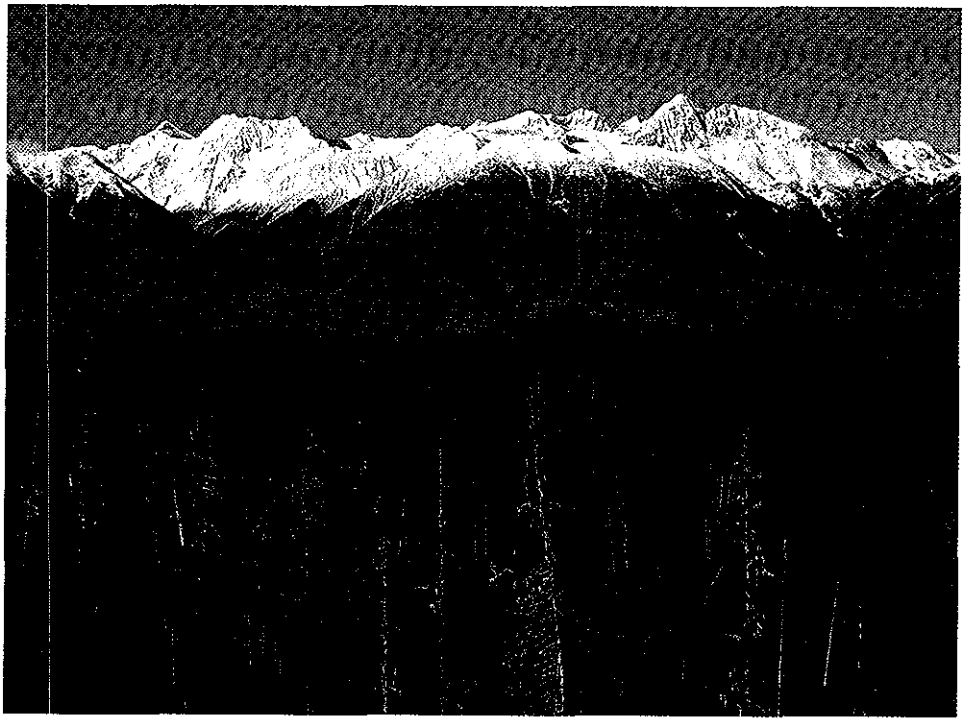
Natural Resources Management in British Columbia, Canada

Of the three projects we visited for this study, the British Columbia (BC) Forest Service initiative is the one that is most explicitly doing adaptive managemenr. We first learned about the BC Forest Service's adaptive management work while on the Internet looking for information on adaptive management. Staff of the BC Forest Service have been prolific in developing tools to make the previously highly technical and somewhat academic concepts of adaptive management much more accessible to practitioners in the field (For more information, go to **www.for.gov.bc.ca/hfp/amhome/amhome.htm**). One result of their efforts is *An Introductory Guide to Adaptive Management for Project Leaders and Participants* (available at **www.for.gov.bc.ca/hfp/amhome/introgd/toc.htm**). Their guide provides an introduction to the concept of adaptive management as it is being implemented by the BC Forest Service, and is an excellent resource for project managers anywhere in the world. During our visit to BC, we spoke with Brian Nyberg and Brenda Taylor in the Victoria offices. We also visited the Kispiox Forest District headquarters in Hazelton where we spoke with Norm Bilodeau, Doug Steventon, Dave Maloney, and other staff.

Conditions That Warrant an Adaptive Management Approach

The BC Forest Service of the Ministry of Forests is responsible for managing the timber, range and recreation resources of British Columbia's unreserved public (Crown) forest land, which covers two-thirds of the province (about 59 million hectares). [34] About one-quarter of this land is managed for commercial timber harvesting, while the other three-quarters are managed for non-commercial timber values, including recreation and cultural heritage. Each year, about one per cent of provincial forest land designated for timber production is harvested.

Within the BC Forest Service, the Forest Practices Branch is responsible for managing the preparation, update, assessment, and refinement of all aspects of provincial forestry policy and standards. Branch staff members provide expert advice and technical support to a broad array of clients, particularly operations field staff. They also assess the effectiveness of forest planning and forest practices standards and propose legislation, policies and procedures to help achieve the ministry's goals and objectives.



Elements of Adaptive Management in This Initiative

One of the key initiatives of the Forest Practices Branch is adaptive management. This initiative includes several components, including the production of educational materials, training programs, advice and support for various project teams, and development of a set demonstration projects where adaptive management is being applied to local issues. In particular, managers in the BC Forest Service use adaptive management as a way of efficiently managing BC's timber resources. According to the BC Web site:

> *Forest ecosystems are complex and dynamic. As a result, our understanding of ecosystems and our ability to predict how they will respond to management actions is limited. Together with changing social values, these knowledge gaps lead to uncertainty over how best to manage British Columbia's forests. Despite these uncertainties, forest managers must make decisions and implement plans. Adaptive management is a way for forest managers to proceed responsibly in the face of such uncertainty.* [35]

One of the most important features of the BC Forest Service's work is that it focuses on local resource managers as the agents of adaptive management. While it acknowledges that scientists are needed to carry out specific research that may be required to answer specific questions, the BC Forest Service seeks to help project managers use sound scientific and management principles to improve decision making. Examples of specific questions that the project managers have considered include: What are the effects of different types of logging road crossings on a stream's ability to provide fish habitat? Or what are the effects of different levels of timber harvesting on the breeding success of key bird species?

Community-Based Natural Resources Management in Papua New Guinea

The focus of our visit to Papua New Guinea (PNG) was the Research and Conservation Foundation (RCF) based in Goroka in Eastern Highlands Province. We have been working with RCF for the last few years through their involvement in the Biodiversity Conservation Network (For more information, go to **www.BCNet.org**). We interviewed John Ericho, RCF's General Manager, and Robert Bino, Manager of the Crater Mountain Project.

Conditions That Warrant an Adaptive Management Approach

Papua New Guinea is reknown for its spectacular biodiversity. From the interior highlands to the coastal plains and coral reefs, PNG is home to birds of paradise, tree kangaroos, and marine invertebrates. Papua New Guinea is also blessed with an extraordinary cultural diversity. Most human populations in the highland live in relative isolation and population pressure on natural resources is relatively low.

RCF grew out of efforts to conserve the Crater Mountain Wildlife Management Area, which covers over 2,600 square kilometers. The site spans a wide range of elevations (150-2,100 meters). Primary forest blankets the lower elevations, while alpine scrub and grasslands occur higher up. Crater Mountain is home to over two hundred bird species, of which 49 are endemic to the region, and 84 mammal species, of which 15 are endemic. Crater Mountain is also home to under a thousand people who are divided into 21 traditional clans across two distinct linguistic groups. Although the area currently has a low population density, a number of threats loom including industrial logging, mining, and oil drilling. These threats are compelling because the companies that would like to access the natural resources of the Wildlife Management Area are offering the local residents who own these resources, relatively large amounts of money compared to their current incomes.

To address the threats to biodiversity, the Crater Mountain project team was formed by RCF working with the Wildlife Conservation Society. The team works in partnership with numerous national and international NGOs, the government of Papua New Guinea, and the local landowners. The project has established several locally owned and operated research and ecotourism and handicraft production enterprises. The tourism enterprises provide lodging and guide services for visiting scientists and for tourists interested in experiencing the natural and cultural wonders of the Crater Mountain area. The project has been working to develop a management plan that provides for both biodiversity conservation and enterprise sustainability.

RCF also executes community development initiatives as incentives for conservation for the local people of the Crater Mountain Wildlife Management Area. Though these initiatives are not directly linked to conservation, significant community development initiatives are being identified and implemented according to the wishes and aspirations of the landholders. RCF envisions that helping the landowners to meet their needs will assist in establishing concrete landholder commitment to RCF's conservation work. As part of this strategy, the RCF Conservation Education Program is designed to raise public awareness in the Crater Mountain Area as a way to develop the knowledge and capacity of local landowners so that they can independently manage the Crater Mountain project in the future.

Elements of Adaptive Management in This Initiative

RCF is a relatively young conservation organization that has evolved considerably since its inception. In 1994, RCF began taking a much more systematic and strategic approach to project planning and management as part of the Biodiversity Conservation Network. Project staff developed a conceptual model of their project and detailed management and monitoring plans so that they could learn about the effects of their interventions. Since that time, RCF has been implementing these plans and has collected a good deal of data about various elements of the project. RCF has on a number of occasions formally revisited and revised their model and plans and is constantly working to develop their organizational learning capabilities.

STEPS IN THE PROCESS OF ADAPTIVE MANAGEMENT

ADAPTIVE MANAGEMENT INCORPORATES research into conservation action. At its core, adaptive management involves the integration of design, management, and monitoring to systematically test assumptions in order to adapt and learn.

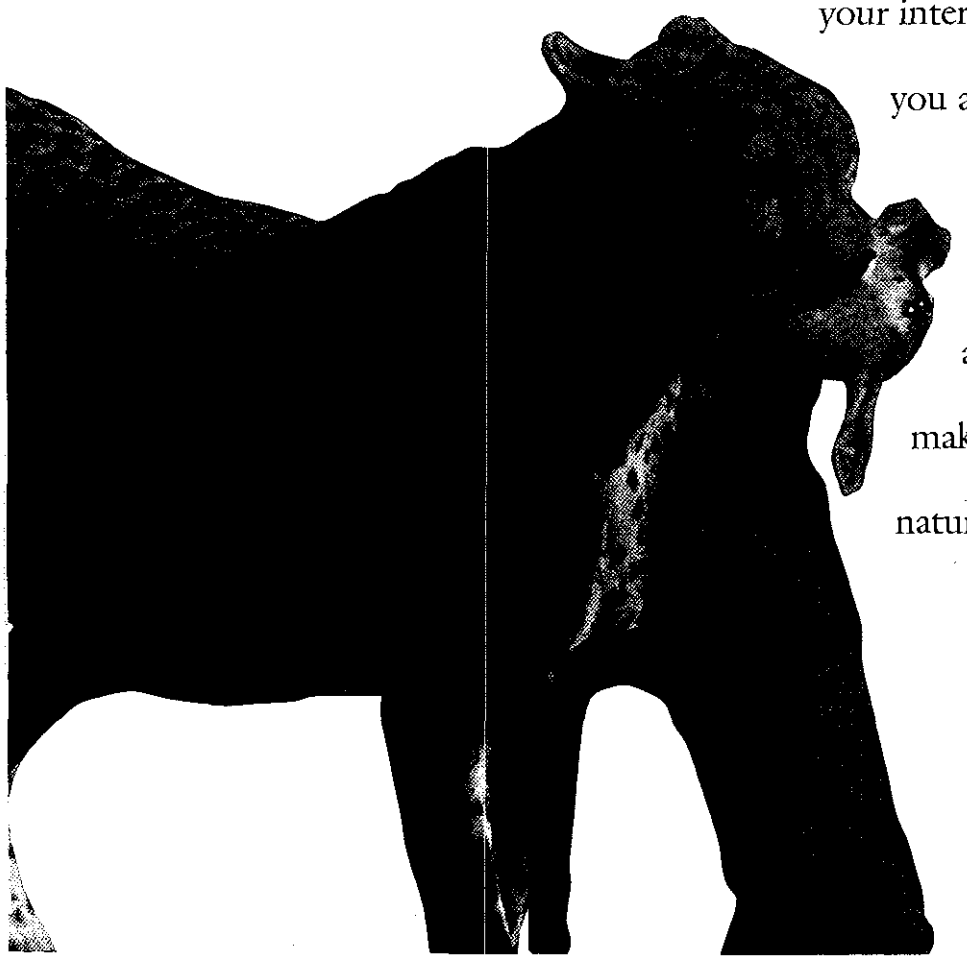
In a conservation project context, adaptive management is about systematically trying different actions to achieve a desired outcome. It is not, however, a random trial-and-error process. Instead, it involves several specific steps described below and in the adaptive management cycle diagram in Figure 2:

START: Establish a Clear and Common Purpose
STEP A: Design an Explicit Model of Your System
STEP B: Develop a Management Plan that Maximizes Results and Learning
STEP C: Develop a Monitoring Plan to Test Your Assumptions
STEP D: Implement Your Management and Monitoring Plans
STEP E: Analyze Data and Communicate Results
ITERATE: Use Results to Adapt and Learn

In this section, we go through the various steps in this cycle. For each step, we first define what it means in the

context of conservation projects. We then turn to our theoretical and practical sources to illustrate why this step is important.

As we will see later, a key premise of this cycle is that adaptive management must be carried out by the same people who are responsible for project design and implementation. In other words, adaptive management must be done by your project team. It cannot be left solely to either outside experts that are not involved in project management or to a special research team that is solely charged with looking impassively at the potential project outcomes while the rest of the team sits around waiting for their results. You and your colleagues are the researchers — you are responsible for testing your own assumptions. Trained scientists can help you answer some questions about the effectiveness of your interventions, but the questions you ask and the answers you get must be relevant to your ability to ultimately adapt and learn. It is up to you to make adaptive management a natural part of the project process.

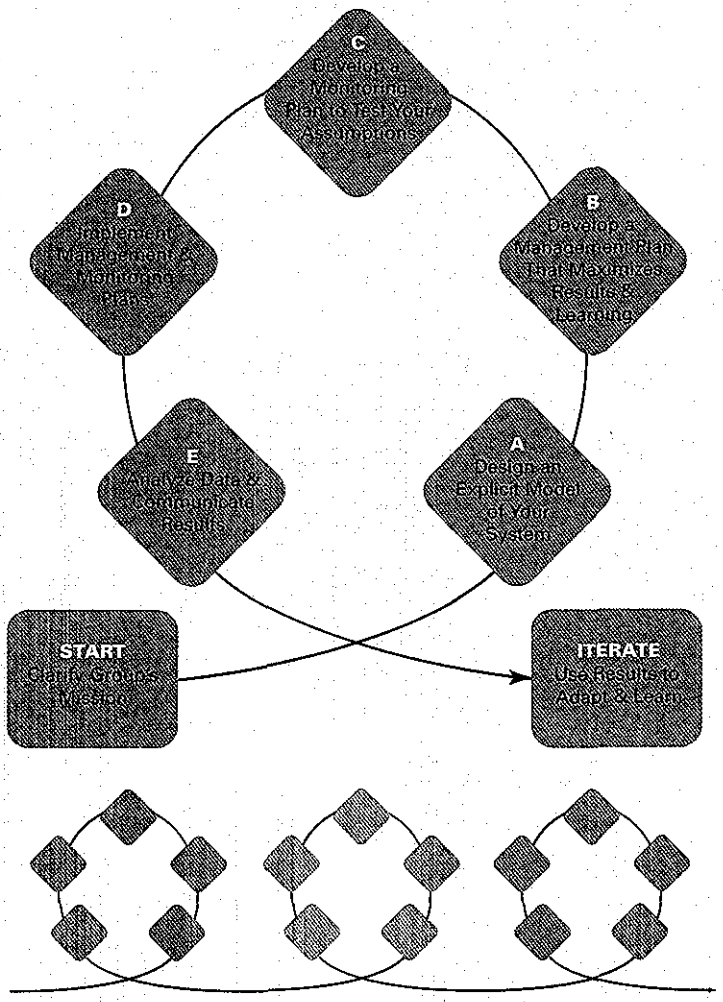


START: Establish a Clear and Common Purpose

The starting point for adaptive management involves clearly defining what it is you are trying to achieve with your project. If you don't know where you want to go, chances are you won't get there. Once you are clear about what the purpose of your project is, you can then determine how you are going to get there — what intermediate steps along the way you must take. Establishing a clear purpose enables you to develop a benchmark for measuring success. Establishing a common purpose enables you to develop effective collaboration among the different members of your project team.

As outlined in *Measures of Success*, to establish a purpose or vision for your project, you need to first determine, broadly speaking, what the mission of your project or organization is. [36] Are you primarily interested in forest conservation? In developing the economic welfare of the local community? In improving the health standards in the region? To be effective, you and the members of your project team must agree on a common mission. Furthermore, you must also negotiate a common vision with the other groups

FIGURE 2. The Adaptive Management Cycle



The starting point of the cycle involves determining who will participate in your project and what your overall mission is. Once this is clear, Step A involves assessing the conditions and determining the major threats to biodiversity at your project site. Using a **conceptual model,** *your project team defines the conditions and relationships between key factors at your project site. Step B involves using this model to develop a project* **management plan** *that outlines the results that your team would like to accomplish and the specific actions that your team will undertake to reach them. Step C involves developing a* **monitoring plan** *for assessing your progress in implementing the project. Step D involves implementing your actions and monitoring plan. Step E involves analyzing the data collected during your monitoring efforts and communicating the information that you obtain to the appropriate audiences. Finally, you use the results of this analysis to change the project and learn how to do projects better in the future. Based on feedback information, you may want to modify your conceptual model, management plan, or monitoring plan.*

Source: Adapted from Margoluis & Salafsky 1998.

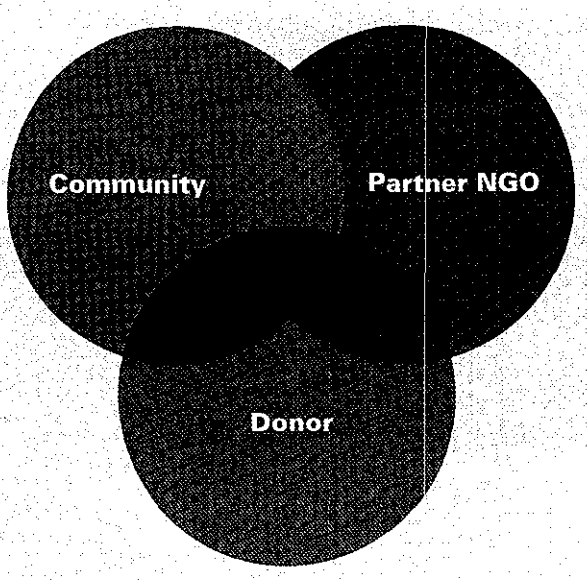
that you will be working with. As shown in Figure 3, it's okay if you and the other groups working together have different missions, as long as you can agree on a common vision for the project.

Once you have established your broad mission, you then need to determine the *target condition* for your project. A target condition is the specific state of the world that you want to focus on. For a conservation project, this target condition might be, for example, "the forest in a certain area" or it might be "the marine resources used by residents of a village." Next, you transform your target condition into a clear operational *goal* for your project. To do so, you need to think about what changes to this target condition you would like to either see happen or prevent. In the examples above, these changes might be "to conserve the forest" or to "promote sustainable use of the marine resources." Finally, you need to make sure that your project partners have a similar goal.

Create a Benchmark for Measuring Success

Establishing a clear vision gives your project meaning by defining a clear destination that you are trying to reach. Establishing a clear goal provides your project with a marker that you can use to measure your success in reaching this vision. Ultimately, effective adaptive management requires knowing both where you are today, and where you want to be tomorrow. As you work toward your goal, you can gauge the extent to which you are achieving it and can then adjust your actions to optimize your realization of this goal. Without a goal, you have no standard against which you can compare progress and no device for measuring progress. Without a clearly defined goal, anyone managing a project can claim success at any time by merely saying at the end that whatever was achieved was the desired outcome. By being clear about your goal at the beginning of a project you are placing a stake in the sand, making your intentions clear, and defining in advance what constitutes success. You are providing yourself the means to measure your own progress.

FIGURE 3. Groups With Different Missions Can Implement a Joint Project



Source: Adapted from Margoluis & Salafsky 1998.

The theoretical sources that we reviewed emphasize the need to be clear about what you want to achieve. Pirsig states that the first step in the scientific process is to "state what condition you would like to change or affect." [37] Similarly, Schön states that problem solving starts with "problem setting, the process by which we define the decision to be made, the ends to be achieved, the means which may be chosen." [38] And Senge states that developing a successful learning organization depends on integrating two visions: 1) An idealistic vision of the future that clarifies what is important to us and helps us know what we really want to achieve, and 2) An honest and accurate vision of current reality that tells us where we really are relative to what we want to achieve. [39]

Many of the project teams that we spoke with also agreed that establishing clear goals is important to provide a framework for measuring success. Dale Lewis of the ZAMBIA ADMADE PROJECT described how ADMADE is very good at measuring the effects of its program. "For us, data collection is very much focused on the dependent variable such as species diversity and population numbers of key species." In a similar fashion, Stephan Forster of the ZAMBIA KANTIPO PROJECT described how they use the numbers of key animals as the measure of their success. In this case, since it can be hard to count animals directly, they can "monitor behavior of animals as a proxy for animal 'health.'"

Promote Informed Collaboration

Establishing a clear goal also helps ensure that the different members of your project team understand and agree on a common end. This step is particularly important to projects that have multiple partners and that seek to address both conservation and development issues. If one group is primarily interested in conservation and the other is primarily interested in development, then unless this difference is clearly understood at the start, it will likely lead to conflict later on. These conflicts will lead to decreased efficiency in project implementation and a higher likelihood that nothing lasting will be achieved. However, groups that have different missions can work together — as long as they are clear about what their specific goal is in working together and how they might complement one another in the context of the project.

The theoretical sources we reviewed agree that clarity about what you want to achieve is also essential to team cohesion. If all team members know what it is they are working towards, then there is a higher likelihood that they will all work together. As Senge writes regarding his discipline of Shared Vision, "One is hard pressed to think of any organization that has sustained some measure of greatness in the absence of goals, values, and missions that become deeply shared throughout the organization." [40]

In our discussions with the project teams, we learned that adaptive management is not a tool for deciding what the broad goal of your project should be. Instead, it can only be effectively used once you and your partners have determined what your goal should be. As Brian Nyberg of the BC FORESTRY INITIATIVE said:

> *It is vital that before you begin, everyone understands what is on the table and what is not. Before you can start working on an adaptive management design for a project on a given piece of land, you must decide what the values are to which the land is going to be dedicated. Anyone who came to the meeting had to decide, for example, that forestry would be pursued on part of the land base. The decision to allocate the land to forestry had already been made and those who wished it could all be a park were not involved. You have to have limited the option space.*

Brian went on to say, "You need to spend time before workshops making sure that the common purpose is agreed upon. Adaptive management is much more effective if you know what you're trying to achieve." In a similar fashion, Dale Lewis of the ZAMBIA ADMADE PROJECT said, "It is very important for everyone to have a very good understanding of 'why' we do things and how we learn. We do this as a team, we discuss everything, to ensure we are all working for a common goal."

The project teams also discussed at great length the problems they faced because of conflicting goals among different stakeholders. Dale Lewis of the ZAMBIA ADMADE PROJECT described how many of the challenges that they encountered occurred because "if you were to ask everyone what ADMADE is about, not everyone has the same understanding of the goals of ADMADE...at the institutional level, ADMADE is about conservation. At the community level, however, ADMADE is about development to meet the needs of local people." John Ericho and Robert Bino of the PNG PROJECT agreed, saying that although the project was set up to achieve conservation goals, the local community is more interested in development. As a result, there has been a great deal of confusion that has hindered the project. It even led to a situation where, as John said, "the villagers in Crater got together and some hot heads said 'these guys have been here for five years and they haven't done anything so let's kick them out.'" To deal with this problem, they had to develop "Two sets of objectives — one set of objectives for conservation and one set for development. We need to work together because they have the forest and we want the forest. So we had to sit down with them and help provide the services that they want."

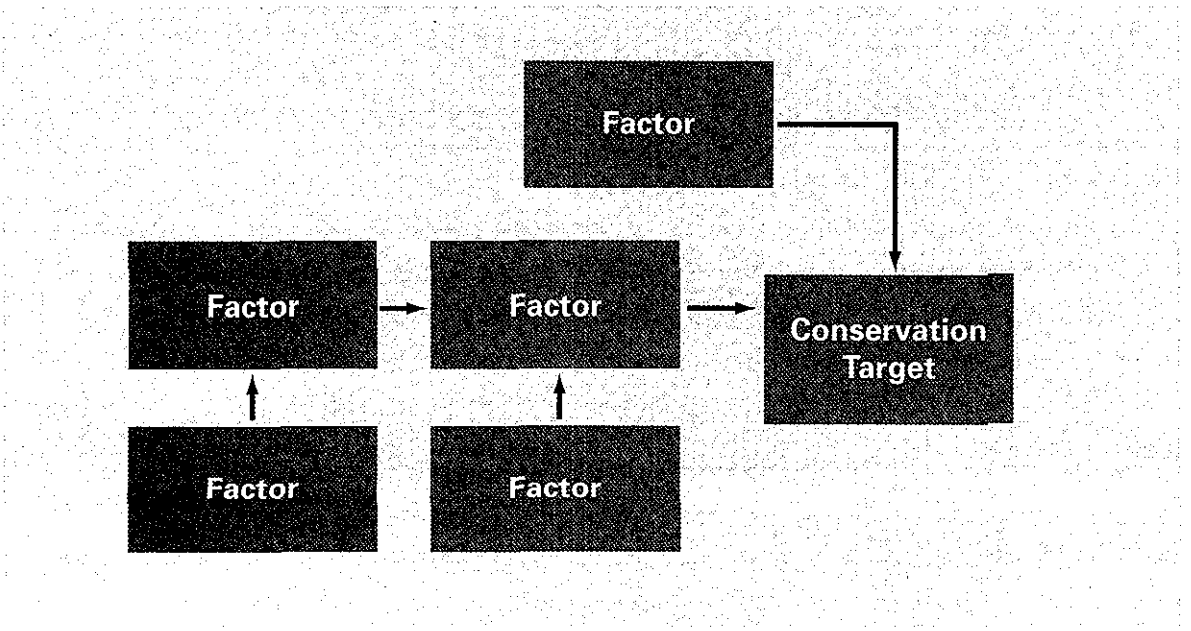
STEP A: Design an Explicit Model of Your System

Once you have set your broad goal, the next step in adaptive management involves developing a shared understanding of the conditions at the site where you are working. Most conservation projects take place in incredibly complex situations. Project managers have to understand the complicated ecosystems that they are working in. If this were not enough, they also have to understand the cultural, social, economic, and political systems that influence the behavior of the many stakeholders at the project site. And all of these different ecological and human factors interact with one another in dynamic and unpredictable ways.

Getting an understanding of the system is typically done through the development of a *model.* Models are simplified versions of reality. They are important for a number of reasons. They help you to organize information. They provide you with a framework for comparing alternative courses of action. They provide an intellectual paper trail that lets you see what the chain of logic was behind a given action. And finally, they provide a vehicle for members of your team to work out a shared view of what is being managed and how the management should be done.

There are many ways of representing key factors, conditions, and relationships that influence biodiversity conservation at a given project site. In our book *Measures of Success*, we outline one process for constructing a conceptual model of your project site. A conceptual model is a diagram of a set of relationships between certain factors that are believed to impact or lead to your target conservation. [41] A good conceptual model presents a

picture of the situation at your project site, showing the assumed linkages between the various direct and indirect threats that affect your conservation target. In abstract form, an initial conceptual model for a conservation and development project looks like:



Collect Relevant Information and Compare Alternative Courses of Action

A good model enables your team to lay out what you think is happening at the project site — it provides a place to collect your team's current knowledge of the existing conditions. Your model should be based on all available information including secondary sources, government records, and most importantly, a thorough needs assessment conducted with the stakeholders at your project site. Once you have collected this information, the model can then help you determine appropriate interventions.

The theoretical sources that we reviewed all talk about the need to develop a formal model of the system that you are working in. For example, a key discipline of Senge's involves using "mental models" that determine not only "how we make sense of the world, but how we take action." [42] He even goes as far as to propose computer-based 'microworlds' that business managers can use as "settings for both crafting visions and experimenting with a broad range of strategies and policies for achieving those visions." [43] Schön talks about how 'problem solving' begins with using models to do 'problem setting,' saying that:

> *In real-world practice, problems do not present themselves to the practitioner as givens. They must be constructed from the materials of problematic situations which are puzzling, troubling, and uncertain. In order to convert a problematic situation to a problem, a practitioner must do a certain kind of work. He must make sense of an uncertain situation that initially makes no sense.* [44]

Lee states that models help to organize information, saying "the usual experience with ecosystem data is that there is not enough to define the biology with any confidence, but far too much for a single human mind to assimilate. Models are indispensable simply to do routine bookkeeping on large quantities of data." [45] Lee also states that once a model has been constructed, it can be used by a manager to compare the potential impact of different policies by testing simulated "what-if" scenarios to test the structure of assumptions built into the model. [46] And finally, Argyris and Schön start their discussion of learning organizations by asserting that "all deliberate action has a cognitive basis that reflects the norms, strategies, and assumptions or models of the world" of the individual or group undertaking the action. This basis is the group or individual's *theory of action*. They go on to use mathematical language to describe how this theory functions saying that this theory of action is basically a guide for the problem: "In situation S, if you want to achieve consequence C, under assumptions *a...n*, then take action *A*." [47]

The practitioners that we spoke with described finding extensive information about their project site and using models to help them sort it out. For example, Stephan Forster of the ZAMBIA KANTIPO PROJECT described how when his project started, they invested in reviewing the secondary data and literature available on Kafue to learn about the area and ended up with a great deal of information. They then started using a problem tree methodology to sort out the information that had been collected. Likewise, Norm Bilodeau of the BC FORESTRY INITIATIVE said:

> *It is important to recognize that a model is only a representation of reality and as such is only useful as a guide. All models are to some degree wrong, otherwise they would not be models. However, models when created and used in a realistic fashion, actually act like an "organizer." They gather complex and wide ranging information and process so that it is more tangible. More specifically they allow us to consider the interrelationships that are impossible for us to fully grasp at a discrete moment of time.*

Likewise, Brian Nyberg of the BC FORESTRY INITIATIVE described why it was critical to use a model to develop a management plan for 40,000 hectares of forest, saying that, "The need for a model becomes much greater to simply explore all the complications associated with that large an area over a long time frame. Nobody can wrap their mind around it, so we are trying to spend much more time on the modeling aspects of the ecosystem management."

Create a Framework for Learning

A good model also enables your team to predict the positive and negative impacts of your activities. These predictions will provide the foundation for learning later on. Once your activities are implemented, you can then go back to your model and see if your assumptions were correct. You can thus use your model as a foundation for learning as you move through the project cycle.

All of the theoretical sources that we reviewed highlight the importance of using a model to make predictions that can be checked over time. For example, Pirsig states that a key step in the scientific method is to use your understanding of the system to predict what will happen once you undertake an experiment. [48] Lee states that a model provides "an intellectual paper trail" that provides "a way of understanding the chain of reasoning that

leads from database to output." He goes on to say that constructing a model is "crucial if learning is to be possible: without an understanding of how one's model of reality works, it is impossible to go back and improve that understanding when reality fails to agree with prediction." [49]

Some of the practitioners that we spoke with had developed explicit models of their projects. These projects found their models to be very helpful in creating a record of their own thinking. For example, John Ericho of the PNG PROJECt said, "I think for me and Robert, it has been very helpful to go through this process of writing a conceptual model and then coming back and having a look at it as the project goes on." Brian Nyberg of the BC FORESTRY INITIATIVE also mentioned that models are important to help new personnel understand what is occurring and to create a "legacy of knowledge." He said:

> *If we're talking about some sort of experimental program that requires tending over a period of decades or more, you can count on there being many changes of the personnel involved in the program. So how do you make sure each successive manager is able to understand what has gone on beforehand? A simple model makes it easy for someone to pick it up and say, "This is what they were thinking."*

The operative word here seems to be "simple." Several of the practitioners that we spoke with described that if models were too complex, they became useless or even counter-productive. For example, Brian Nyberg of the BC FORESTRY INITIATIVE said that on occasions, he became very frustrated with complex computer models. He described being involved in creating an elaborate simulation model that looked at the relationship between deer and elk and their habitats in coastal forests. He said, "It looked very neat and tidy," on the screen, but "these simulation programs never worked in the real world. We poured in all this money and time and effort, and people stayed up all night and my conclusion at the end was that it told us essentially what we already knew before we started. The model gave very precise and unreliable predictions based on very imprecise knowledge of the modeled system." He goes on to conclude that the key for us is to "simplify the mathematically focused adaptive management stuff that's in the literature — you have to ensure that whatever is produced gets used."

Synthesize Different Perspectives

Another important reason for creating a model of your site is that it enables people to make their different perspectives explicit and to then work out a shared understanding. People often seem to believe that other people see the world in more or less the same way that they do. If you ask a diverse group of stakeholders to develop a model of a given site, they will often act offended and claim that it will be easy to do. Many hours later, however, they are still there at the table, arguing about what causes what and what factors are most important.

The theoretical sources that we reviewed support the importance of using a model to create a common understanding of the situation in the system where you are working. As Lee says:

> *The process of building a model is a way of working out a shared view of what is being managed and how the managing should be done. Often that process is conducted by a diverse group of people drawn from different organizations, some of them organizations with conflicting interests...when this happens, model building becomes a way of negotiating.* [50]

In a similar fashion, Senge proposes using models to "make your reasoning explicit and encourage others to explore your views...and provide different views." He goes on to say:

> *Our mental models determine not only how we make sense of the world, but how we take action...Why are mental models so powerful in affecting what we do? In part, because they affect what we see. Two people with different mental models can observe the same event and describe it differently, because they've looked at different details. When you and I walk into a crowded party, we both take in the same basic sensory data, but we pick out different faces. As psychologists say, we observe selectively. This is no less true for supposedly "objective" observers such as scientists than for people in general. As Albert Einstein once wrote: "Our theories determine what we measure."* [51]

And in a similar fashion, Argyris and Schön state:

> *When the task is large and complex, most members are unable to use face-to-face contact in order to compare and adjust their several images of organizational theory-in-use. They require external references. There must be public representations of organizational theory-in-use to which individuals can refer. This is the function of organizational maps. These are the shared descriptions of organization which individuals jointly construct and use to guide their own inquiry. They include, for example, diagrams of work flow, compensation charts, statements of procedure, even the schematic drawings of office space...they describe actual patterns of activity, and they are guides to future action.* [52]

Many of the practitioners that we spoke with agreed that models were useful for bringing different perspectives together. Brian Nyberg of the BC FORESTRY INITIATIVE said that, "Many of the people who come to our meetings already have a common model of how they think things work. The more heterogeneous the group, the more important the jointly-developed model." He went on to say that the nature of the model is not important, but that, "What is important is that people have a common understanding of their assumptions, be it a model or boxes and arrows, or literally pictures. It is crucial to have a model that everyone understands." Other practitioners that we interviewed had not necessarily developed explicit models of their project. But these practitioners agreed that they had at least implicit models. For example, Dale Lewis of the ZAMBIA ADMADE PROJECT said, "there is a shared model that is implicit in every key person's mind — a kind of internal conceptual model." Furthermore, in talking about the problem of getting new project staff to understand the vision, Lewis said, "Boy it would be great to have something like that."

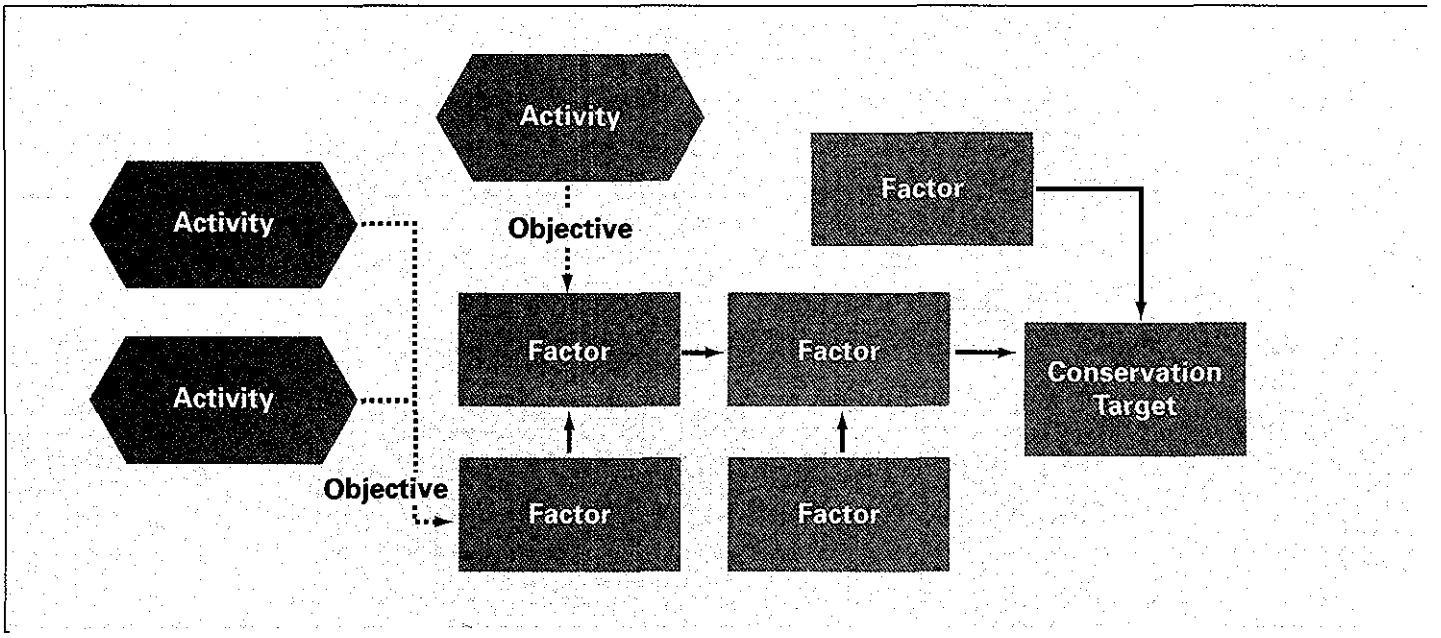
STEP B: Develop a Management Plan That Maximizes Results and Learning

After you have developed a model of your site, the next step in adaptive management involves figuring out what actions you are going to take. If you were starting your project with this step, trying to figure out what actions to take would undoubtedly be an overwhelming process. In any given system, there are generally hundreds if not thousands of different things you can do. Despite the wealth of options, you only have limited staff, limited money, and limited time. You can't do everything. Furthermore, you will probably be unsure what a given action will produce. So how do you decide what to do? In some of the worst cases, practitioners seem to just try

different actions more or less blindly, hoping that they will work. At the other extreme, some practitioners seem to have settled on a small subset of actions — like environmental education, sustainable agriculture, or strict protection — that they believe will necessarily lead to conservation in all situations. Not surprisingly, the results of these interventions are usually mixed at best.

However, if you've developed a conceptual model of your project site that shows your target condition and the threats to it and other factors that affect it, then you are in a much better position to figure out what steps to take. The key here is to develop a *project management plan* that outlines the factors that you want to affect and the specific actions that you will undertake to change them. Instead of focusing on the actions that you will ultimately take, first think about the specific results that you want to achieve and then base your selection of activities on how best to achieve them. By doing so, you can maximize your potential to leverage change on the system with the resources you have. You can also set up experiments that will help you learn which actions work and which do not. And finally, you can make more informed decisions as to how to balance the risks of action and inaction.

Developing a management plan starts by ranking the various threats that you have identified in your model and deciding which are causing the biggest problems and which are most easily addressed. Once you have selected which threats you think you might want to address, you then use your model to determine which factors linked to those threats you might be able to change to thus change the threat. After selecting a factor that you think you can affect, the next step is to develop a specific *objective* for that factor. As outlined in *Measures of Success*, objectives are specific statements detailing the desired accomplishments or outcomes of a project in relation to specific factors. [53] Once you have developed the specific objectives that you want to accomplish, the next step is to develop the activities that will enable you to accomplish this objective. Activities are specific actions undertaken by project staff to reach each of the project's objectives. [54] The key to the management plan is that each objective is targeted at a specific factor in the model that is linked to the target condition. If the theory is correct, completing all of the activities will enable the project to meet its objectives and ultimately change the target condition. In simplified form, a final conceptual model that includes activities and objectives looks like:



Maximize Leverage

Using your model to select your actions can help your team to figure out which threats you need to address. It also enables you to figure out how to most effectively use your resources to counter these threats. Ideally, it will let you determine how you think that you can get the most impact on the system for the least effort. Perhaps even more importantly, you can also use your conceptual model to decide what actions you are not going to take. For example, if your model shows that using a certain tool is not going to impact the key threat factor or is not going to have sufficient impact, then you don't want to be wasting your project's money and time using that tool.

The theoretical sources that we reviewed underscore that too often managers seem to make decisions in an unsystematic fashion. As Senge writes:

> *Many American managers are too busy running to "think on their feet." Even when there is ample time for reflection and the facility for retrieving all manner of relevant information...most managers do not reflect carefully on their actions. Typically managers...adopt a strategy, then as soon as the strategy starts to run into problems, they switch to another strategy, then to another and another...managers may run through three to six different strategies, without once examining why a strategy seems to be failing or articulating specifically what they hope to accomplish through a change in strategy. Apparently, the "ready, fire, aim" atmosphere of American corporations has been fully assimilated and internalized by those who live in that atmosphere.* [55]

To counter this problem, the sources we reviewed emphasized the need to select actions based on your model. For example, Argyris and Schön discuss how one of the most important parts of the planning process is to figure out what you are going to do, saying that all groups need three maps:

> *The first is a map of where the organization is; the second is a map of where it wishes to go; the third is a map of how to get from here to there. Without the third map, knowing where you are may be interesting, but not helpful for change; knowing where you would like to go becomes an exercise in abstractions; and knowing only both can lead to frustration and a sense of helplessness.* [56]

Most of the sources also discuss how it is important to select these actions in a systematic fashion to maximize your impact on the system. Senge emphasizes that small, well-focused actions can sometimes produce significant, enduring improvements, if they're in the right place. Senge refers to this principle as "leverage" and states that "tackling a difficult problem is often a matter of seeing where the high leverage lies, a change which — with a minimum of effort — would lead to lasting, significant improvement. He goes on to describe how the most effective way to change a system is to "change the behavior of the system...[by] identifying and changing the limiting factor." [57] Likewise, Holling and his colleagues realized that although ecosystems are complex, everything is not strongly connected to everything else. Instead, ecosystems are non-uniform over space and time. [58] As a result, actions changing one part of the system can have dramatic effects on another part of the system. The key is to understand the system well enough so that you know where these high leverage points exist.

Robert Bino of the PNG PROJECT team echoes this concept when he said, "Our conceptual model assists project managers and planners to consider all factors affecting and influencing the project instantaneously and holistically. An important advantage is that an intervention activity that impacts a variety of factors instead of one can be

identified and capitalized on. This benefits the project by reducing the costs of project activities and maximizing the scope and intensity of the leverage."

For the most part, however, the project teams that we spoke with put a fair amount of thought into deciding what actions to take, but had *not* necessarily been completely systematic in this process. For example, Brenda Taylor of the BC FORESTRY INITIATIVE described how members of their agency went about trying to solve a problem caused by destructive parties that were being held at campsites that they were managing. She said that the team certainly considered various options and responses ranging from hiring on-site supervisors to having police conduct spot-checks to physically "hardening" the site against potential damage. But as she said, "I don't think we went about it in a systematic way looking at the linkages, but I think we did think about them." She goes on to describe how they used cost and potential effectiveness as their primary criteria for selecting actions.

Treat Your Actions as Experiments

Although ideally you will be looking for high leverage actions, in most cases it may not be completely clear what the best activity to take might be. This problem typically occurs when your understanding of the situation is not complete or uncertain. In these cases, you will want to at least try one action and make predictions as to what the results will be. If it works, great. If not, however, then you can learn from the results and try something else in the future. You might even want to try implementing two or more different actions to be able to compare them more systematically. Taking action while confronting uncertainty is what adaptive management is all about.

This difficulty in finding the high-leverage actions is perhaps best summed up by Senge who says, "the only problem is that high-leverage changes are usually highly *nonobvious* to most participants in the system." [59] Because of this uncertainty, it becomes necessary to experiment through one's actions. As Schön says, "in the most generic sense, to experiment is to act in order to see where the action leads to." Holling and his colleagues agree, stating that if a policy is viewed as a hypothesis, then the implementation of that policy becomes the mechanism by which the hypothesis is tested or evaluated. As Lee puts it, "adaptive management is highly advantageous when policy makers face uncertainty." He goes on to say:

> *Because human understanding of nature is imperfect, human interactions with nature should be experimental. Adaptive management applies the concepts of experimentation to the design and implementation of natural resource and environmental policies. An adaptive policy is one that is designed from the outset to test clearly formulated hypotheses about the behavior of an ecosystem being changed by human use...If the policy succeeds, the hypothesis is affirmed. But if the policy fails, an adaptive design still permits learning, so that future decisions can proceed from a better base of understanding.* [60]

To deal with the problem posed by uncertainty, the theoretical sources that we consulted all emphasize the importance of experiments and discuss different types of experiments that can be undertaken. Holling and his colleagues describe two main types of experimentation. [61]

- **Passive experimentation** does not involve experimental manipulation of the system being studied. Instead, passive experimentation works best in systems that have a high degree of variation. This variation creates "natural" controlled experiments enabling managers to test the validity of their assumptions without

intervening themselves. For example, a patch of forest being harvested using state-of-the-art methods can be compared to a similar patch of forest that is not being harvested. A major advantage of the passive approach is that it tends to be simpler and cheaper to implement. A disadvantage, however, is that it ignores the uncertainty surrounding the policy and basically assumes that it is correct.

- **Active experimentation**, on the other hand, embraces both uncertainty and deliberately experimental management policies. In pursuing an active experimentation approach, a manager will try multiple strategies to determine which one is most effective. For instance, the forest manager may try several different harvesting options in different sections of the forest. This deliberate experimentation is more expensive to implement. Furthermore, trying multiple policies necessarily means that sub-optimal ones are being tried which will impose a short-term cost in terms of resource output. The pay-off, however, comes in enhancing the long-term learning about the system. Holling and his colleagues emphasize that adaptive management fundamentally involves active experimentation.

There are many ways in which to do active experimentation. Schön identifies several types of experiments that the practitioner can undertake including:

- **Exploratory Experiments** — When action is undertaken only to see what follows, without accompanying predictions or expectations.
- **Move-Testing Experiments** — When action is taken in order to produce intended change.
- **Hypothesis Testing Experiments** — When action is undertaken to discriminate among competing hypotheses. [62]

Schön states that reflection-in-action involves a combination of all of these types of experimentation, "When the practitioner reflects-in-action...his experimenting is at once exploratory, move testing, and hypothesis testing." [63]

The practitioners that we spoke with who were familiar with the theoretical background of adaptive management endorsed the idea of trying something and then learning whether or not it worked — exploratory and move-testing types of experiments. For example, Robert Bino of the PNG PROJECT described how they tried sending local community members on a tour of other areas that had been logged so they could see the effects. As he said, "We didn't know what it would be like when we went the first time. The result was quite good. As a result, we decided to keep doing the tours to expose other villagers to the effects of logging." He also described how the project would pilot an activity in one village — for example putting women on the management committee board — and then wait and see if it worked before trying it in all of the villages.

The BC FORESTRY INITIATIVE team members also described a number of move-testing and hypothesis-testing experiments that they had undertaken. For example, Norm Bilodeau and his colleagues described how they were concerned about the effects of logging road bridges on the fish populations of the streams that the bridges were built over. One set of experiments revolved around the testing of "best management practices" to develop road and bridge designs. It involved monitoring sedimentation and water temperature upstream and downstream from bridges, effectively using the bridge crossing as a "point source" to assess the success of different bridge construction and management options. Another set of experiments involved cutting timber on different stands at different densities — removing 30% of the trees on some plots and 60% on others — to see what the effect was on

wildlife using migratory bird nesting and brood success. This experiment generated some interesting results. For example, Norm Bilodeau and Doug Steventon of the BC FORESTRY INITIATIVE described how they found they could generate an increase of up to 185% in available timber supply by instituting a partial cutting regime on at least 50% of a working area because of the way the clearcutting is regulated by legislation. As Steventon put it, "this kind of innovative management flies in the face of convention. It has to be tested on more than one watershed to really know if it's going to work."

For the most part, however, the practitioners that we spoke with had not done many hypothesis-testing experiments. In some cases, this was because they hadn't worked up to it yet. As Stephan Forster of the ZAMBIA KANTIPO PROJECT said, "We did not test alternatives, but it would be fascinating. We are just now becoming aware of what actions to apply where — and that these actions are not uniform across the whole area." In other cases, the practitioners said that they found the idea of formally experimenting and trying alternative courses of action was a hard concept to implement with the stakeholders that they were working with. As Brenda Taylor of the BC FORESTRY INITIATIVE said:

> *Laying out alternative outcomes and alternative actions is a good idea in theory. It just doesn't always work out that way when you actually try to do it. People don't come to these workshops with all the background knowledge of adaptive management and all these mental models of adaptive management that we have. Sometimes, it's hard even getting them to define objectives and define indicators and define actions for the primary program they are going to do, let alone other actions. I guess I think that it is great to do it — if you can get people to do it, I think it should be done. But, it doesn't always get done.*

Balance the Risks of Action and Inaction

Adaptive managers are somewhere between pure practitioners and pure researchers. A pure practitioner (if such a thing exists) is only interested in taking action to change the world. A pure researcher, on the other hand, is only interested in learning about the world, regardless of what happens to it. An adaptive manager is somewhere between these two endpoints and has to balance the risks of taking the wrong action in the face of uncertainty and the risk of not acting when action is necessary.

The theoretical sources that we reviewed extensively discuss the difference between a traditional "objective and unbiased" researcher and an adaptive manager who seeks to change the world. As Schön writes, unlike the traditional researcher:

- *The practitioner [seeks to] make his hypothesis come true.*
- *The practitioner violates the canon of controlled experiment, which calls for objectivity and distance.*
- *But, although the practitioner seeks to make the situation conform to his hypothesis, he remains open to the possibility that it will not.* [64]

One consequence of this different attitude between researchers and adaptive managers has to do with the amount and type of risk that they are willing to accept. Kai Lee discusses this problem by comparing scientists and fire fighters. A traditional scientist is, in Lee's words, "an idealist, someone who does not want to claim that something

is true that turns out later to be false." Scientists strive to avoid what are known as Type I errors — affirming a statement that turns out to be false. For a fire fighter, by contrast, "the cost of responding to a false alarm (making a Type I error) is much less than not responding to a real fire (making a Type II error)." As a result, the fire fighter answers all calls, even if most of them turn out to be false alarms. Lee's point here is that both conservationists and adaptive managers need to be somewhere between the extremes posed by the scientist and fire fighter. On the one hand, you don't want to state something as being true when it isn't. On the other hand, you have to be willing to act in the face of uncertain knowledge — even if it turns out to be false. As Lee points out:

> *The problem is, we live in a changing world. It is a world in which forces already in play will bring about unwelcome results unless they are channeled or regulated...there is a cost to not acting.*

One example of this challenge that Lee goes on to give is determining what policy to pursue to save the California condor from extinction. As Lee states, "The problem is whether to risk a Type II error — allowing the condor to go extinct when it could have been saved — or to chance a Type I error — killing the last condors in an attempt to preserve their kind, when they might have survived unaided." [65]

The practitioners we interviewed also talked about how being a good adaptive manager requires the ability to stomach some degree of risk in taking action. For example, Dale Lewis of the ZAMBIA ADMADE PROJECT talked about the benefits of taking risks saying:

> *My father is a stockbroker. He is a gambler. I'm not a gambler. I learned not to gamble. But it is fun to take risks. The key is to use it to push you into the new unknown where there are opportunities for new insights. I look for the intellectual excitement that comes when you've learned something new. It is these types of risk that help us to shape our understanding and perception of how ADMADE could evolve.*

Likewise, Norm Bilodeau of the BC FORESTRY INITIATIVE described their use of bird nesting and brood success for wildlife monitoring relative to the experimental removal of different densities of timber. "Obviously, the whole premise is that the scoping exercise and the bracketing exercise were used, formulated and implemented in such a way to try to minimize risk to wildllife. But the reality is that I think there is still an underlying risk in our assumptions that we have to embrace, and that is just the way it is. Stuff happens." In a similar way, John Ericho of the PNG PROJECT described some risks that they took in terms of their different project activities. He said "At some point, we just have to move forward and do what we think is right."

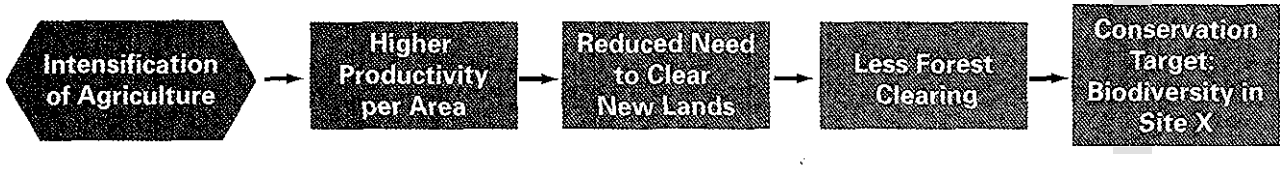
STEP C: Develop a Monitoring Plan to Test Your Assumptions

Once you have selected the actions you are going to undertake, the next step in adaptive management involves determining how you will monitor the assumptions behind your actions. "Monitoring" and "evaluation" are becoming increasingly common words in conservation projects. Unfortunately, in many conservation projects, people have a hard time figuring out what they should be monitoring. So in many cases project team members start out by trying to monitor a long list of indicators. They send out an army of researchers who collect lots of data that then ends up collecting dust in big piles on office shelves. The project team then gets frustrated and goes back to not monitoring anything.

Many of the problems people have with monitoring result from the fact that they are not clear why they are doing monitoring. There are two primary reasons for monitoring a project. The first is so that you can convince other people that you are doing what you set out to do. This type of monitoring is typically done to satisfy donor requirements or to help your boss or board of directors conduct a performance evaluation. The second is so that you can learn whether your actions are working or not working so that you can take corrective action if needed. From an adaptive management perspective, you should be much more interested in the second reason. You undertake monitoring because you want to see whether you are being effective and to learn how to improve. In particular, adaptive management requires testing explicit *assumptions* about your project and collecting only the data that you need to test these assumptions.

As described in more detail in *Measures of Success*, if you've developed a conceptual model of your project site and have selected activities that are focused on key factors, then figuring out what to monitor becomes much easier. In particular, you will want to focus on your key assumptions — the cause-and-effect chains that lead from a certain activity to a factor and ultimately to your conservation target as shown in Figure 4. Identifying information directly related to your assumption is relatively straightforward. To do this, you simply think about what *indicators* you might need to confirm that each link along the chain is or is not occurring. For each indicator, your complete *monitoring plan* will also contain what method you will use to collect data on the indicator, and how, where, and by whom these data will be collected. [66] In addition to factors related to your key assumptions, you may also need to use your conceptual model to determine what other contextual information you need to collect. The challenge here is to avoid collecting too much data, and instead focus on the critical factors that are most relevant to your project.

FIGURE 4. A Sample Cause-and-Effect Assumption Chain



Make Your Assumptions Explicit

The starting point for monitoring is determining what information you need. The most important data that you will collect are those that will tell you whether your actions are having their desired effect. To this end, you need to make your assumptions explicit. As discussed above in the section on models, too often people seem to think that other people view the problem in the same way as they do. Making your assumptions explicit enables you to be clear about what you are predicting.

The theoretical sources that we reviewed agreed with the need to formally and explicitly state assumptions or hypotheses. A key part of problem setting involves developing your hypotheses, or as Pirsig puts it, formal statements of your assumptions as to what is causing the problem. [67] This explicit statement is necessary because as Argyris and Schön state, in many cases the theory that organizations or individuals say they have may be different then the theory that they actually use. To this end, Argyris and Schön distinguish between *espoused theory* — that which is stated, and the *theory-in-use* — that which is carried out. [68] Senge echoes this thought, when he quotes Deming as saying "If we cannot express our assumptions explicitly in ways that others can understand and build upon, there can be no larger process of testing those assumptions and building public knowledge." [69]

The practitioners that we spoke with agreed that it is important to lay out your assumptions. Perhaps Brian Nyberg of the BC FORESTRY INITIATIVE said it best:

> *I think it is very important that people have a common understanding of what their assumptions are. However you do that, whether you do it by box and arrow diagrams or whether you actually use the simulation model or whether you just talk about it, whether you draw little graphs or even pictures, there are a bunch of different ways you can get people to represent what their assumptions are. I think it is worthwhile trying to get them to do that because sometimes people don't realize what their own assumptions are until they hear what someone else's are and realize theirs are different.*

In a similar fashion, Robert Bino of the PNG PROJECT said:

> *When assumptions are explicit, project managers get a better sense of the general outcome of the nature of the impacts of their intervention activities. In our project, we get a better picture of local landholder reactions to the level of income earned through the established eco-enterprises. We can then gauge whether their complaints about not receiving enough money are due to actual low income levels or are related to other factors such as the handout mentality that seems to have been cultivated in the community.*

In some of the other projects, the practitioners had not formally laid out their assumptions, but were able to state some of them during our conversation. For example, Dale Lewis of the ZAMBIA ADMADE PROJECT said, "We do not explicitly lay out assumptions but recognize them internally. We test assumptions intuitively, adaptively." One specific assumption that Dale mentioned was a belief that they had early on, that clan chiefs would be good role models and leaders for the community. They found over time, however, that this turned out not be to true and had to modify their actions accordingly. Other examples of key assumptions that the ADMADE project identified included:

- By expanding the safari industry, the local economic resource base will improve,
- Economic incentives from safari hunting will be sufficient to make people stop poaching,
- The income that can realistically be derived from safari hunting (which is limited by the nature of the resource) will be of sufficient importance to the community to make them want to manage the wildlife.

Dale was also clear that the main reason for testing these assumptions was to learn whether their actions were working. As he said, "you have to get to cause-and-effect in conservation — that's the science of it. That's what drives what we do. We (Nyamaluma) provide the objective analysis of information to make good decisions."

Some of the people we interviewed also noted that while laying out assumptions was important, in the words of Brian Child of the ZAMBIA SLAMU PROJECT "it takes a long time and is difficult to do." This problem is particularly evident when as Brenda Taylor of the BC FORESTRY INITIATIVE said:

> *It comes back to what I said at the beginning about models and how that's been our weakness — all these steps all kind of relate to each other. If you don't have your conceptual model with specific assumptions laid out, then you can't test those assumptions explicitly. Laying out assumptions has been our weak area. It may be because we've been trying to get something going on the ground and we didn't want to get hung up too much on talking about assumptions. Or maybe because it's hard to get people to understand the ideas in the limited amount of time that we have. Or in some cases because we haven't needed to — the assumptions have been more or less explicit and we're dealing with people who haven't radically disagreed with each other.*

Collect Only the Information You Need

Stating your assumptions in a clear fashion will enable you to figure out what data you need to collect to test them. This includes designing the appropriate comparison and selecting the right indicators to measure. In figuring out what indicators to use, you need to keep in mind that having lots of data does not necessarily translate into having good information. In fact, you may find that having lots of data on unrelated topics may actually make it harder to find and use the specific bits of data that you actually need to test your key assumptions.

Pirsig states that the key skill for researchers "consists of using experiments that test only the hypothesis in question, nothing less, nothing more." [70] Perhaps not surprisingly, however, the other theoretical sources that we reviewed do not spend a lot of time discussing the practical problem of figuring out how to collect only the data you need. They all seem to assume that data will come if an experiment is well designed.

The practitioners that we consulted with, on the other hand, all felt that determining what data to collect is a major problem. They strongly agreed that as a rule, projects collect too much data. Stephan Forster of the ZAMBIA KANTIPO PROJECT said, "I have seen data collection that is huge — piles of questionnaires filled in by enumerators and that's it — no analysis, no use of the information — it's a waste of paper and manpower." He goes on to say "there is certainly no point developing a log frame filled with indicators that you're never going to be able to collect, analyze, and use."

Brenda Taylor of the BC FORESTRY INITIATIVE agreed, saying, "People, especially scientists, they all have their pet things they like to measure, and they all think they need to measure 50 things in order to really understand it, but in order to make a decision sometimes you really only need to measure two." Her colleague Brian Nyberg echoed this thought when he said:

> *We have been trying to develop an approach that is replicable in many other settings, in many other groups of people. We've been trying to develop examples of what were realistic and feasible approaches to doing things, and because of limited people and limited resources in every case, we knew that we have to keep things very simple. Get the minimum amount of information that is useful for understanding how the system works or for making future decisions, and get only that. And, force people to back away from their preferred option or preferred set of indicators if they couldn't show how each of them was going to be used to contribute to either understanding or decision. So, we've been fairly tough on some people. One scientist who was involved in the discussions about McCully Creek must have taken two or three hours of attack on his proposed indicators before he finally recognized that everybody else was going with only two, so why should he have 23?*

Likewise, the PNG PROJECT describes how they set up an ambitious monitoring program, but that they have, to date, not been able to use most of the data. The project team was very enthusiastic about collecting different variables. Not enough thinking went into what might actually be useful — or how it would be used.

To solve these problems, the practitioners agreed that you have to focus on a simple set of indicators that are tied to the assumptions you are making. As Stephan Forster of the ZAMBIA KANTIPO PROJECT said, "It is much more important to have indicators that are simple, simple, simple — and measurable." He goes on to say that, "In KANTIPO, all monitoring is linked 100% to management of the project." Likewise, Brenda Taylor of the BC FORESTRY INITIATIVE said, their focus has been:

> *What is going to work, and what are you going to measure to figure out if it worked or not? That's I guess what our emphasis has been. And that's how we come up with indicators. What is the minimum you need to know in order to evaluate whether it worked or not?*

At the same time, however, it is also important to understand the limitations of the indicators that you do decide to go with. As Norm Bilodeau of the BC FORESTRY INITIATIVE said:

> *Indicators are a contentious concept for many scientists. There is a tacit assumption that their use will preclude the need to consider the systematics involved. Clearly it is in the way they are used. Indicators are essentially qualitative measures with enough quantitative value to be dangerous if used inappropriately. It's like using a watch without a second hand to time a race. As long as you are not trying to determine a winner with the watch it is not a problem. I like to think of indicators as a compass guiding us towards better decisions.*

STEP D: Implement Your Management and Monitoring Plans

Up until this point, the steps in the process of adaptive management have involved planning — developing a broad goal, a conceptual model, a project management plan outlining the actions you will take, and a monitoring plan. This planning is important and takes a great deal of work and energy. But in the end, plans are only pieces of paper with ideas on them. The key is to turn this planning into action and to then make sure that you collect the data that you have identified as being important in your monitoring plan.

As we said in *Measures of Success*, there is not a whole lot of advice that we can give practitioners about implementing your management plan, other than just do it!

Do It!

Adaptive management is not a theoretical exercise. Instead, it is fundamentally about taking action. As a result, the most critical step in the entire process involves implementing your management plan.

The theoretical sources that we reviewed agreed that action is a fundamental component of adaptive management. Lee describes how adaptive management "applies the concept of experimentation to the design and implementation of natural-resource and environmental policies." [71] And for Schön, the analytical part of reflection-in-action takes place in the context of the everyday work of professional practice:

> *When someone reflects-in-action, he becomes a researcher in the practice context. He is not dependent on the categories of established theory and technique, but constructs a new theory of the unique case...He does not separate thinking from doing, ratiocinating his way to a decision which he must later convert to action. Because his experimenting is a kind of action, implementation is built into inquiry.* [72]

As Schön points out, the practitioner's experimentation is different from that of the traditional scientist:

> *The practice context is different from the research context in several important ways, all of which have to do with the relationship between changing things and understanding them. The practitioner has an interest in transforming the situation from what it is to something he likes better. He also has an interest in understanding the situation, but it is in the service of his interest in change.* [73]

The practitioners that we spoke with agreed with the need to take action. To this end, they identified a major problem that we might call "planning paralysis." People get so preoccupied with planning that they never move forward with implementation of the project. As Brenda Taylor of the BC FORESTRY INITIATIVE said, "often the stuff you hear or read in the literature is about how they get stuck in the modeling stage. They spend all this time and effort and money and energy producing a model and then they don't do anything else. We wanted to get beyond that and actually get into the management, to actually getting stuff going on the ground." Her colleague Brian Nyberg echoed this sentiment when he said:

> *Because we have been anxious to get projects going we may have not spent enough time on working on the model. This was a reaction to the current [adaptive management] practice that spends most of the time on*

> *the model. We have had an emphasis on action and not wringing our hands. The people we work with have "had it up to here" with planning. They were sick of it and wanted to get on with doing something. The purpose of this program was to do adaptive management, not build models.*

A second related problem that emerges is what we might term "model rigidity." Often when a group spends a great deal of time and energy building a conceptual model, for some reason they can begin to regard it as being "set in stone." As a result, the group becomes reluctant to change it over time. The key is to remember that the model has to change as the situation where you are working changes. For example, Norm Bilodeau of the BC FORESTRY INITIATIVE talked about the importance of creating a living model when he described some new work that they were undertaking with forest products such as mushrooms. He felt that in doing so, they avoided both the trap of "not starting work until the model is finished" and the trap of not taking on new activities because "they are not specified in the plan." As Bilodeau said, "you've got to be good jugglers in this business."

Set Up a Data Management System That Fits into Everyday Work

In addition to implementing your management plan, you also need to implement your monitoring plan. As you do so, you need to figure out what to do with all the data streaming in. To this end, each project needs to set up a data management system. In developing documentation systems, you need to think about both the ease of input and export of your information. If you store your information on a Web site using a computer located far away from your field site, chances are that it may be hard to record your experiences on a regular basis. If, however, you write your information down in a notebook, then it may get lost or be hard for other people to read. The key is to find ways of recording your findings that are both part of your normal routine and yet accessible to others.

The theoretical sources that we reviewed agreed that it is important to keep track of not only your final results, but also the steps in the process of getting there. For example, Pirsig describes how most research scientists keep a lab notebook in which they write their hypothesis, objectives, methods, results, and conclusions for each experiment that they conduct. As Pirsig says, by doing so, "you know at all times where you are, where you've been, where you're going, and where you want to get...sometimes just the act of writing down the problems straightens out your head as to what they really are." [74] When something goes wrong, this written record also enables the researcher to go back and "debug" the process to figure out what happened. In a similar fashion, Lee emphasizes the need to create an "intellectual paper trail, a way of understanding the chain of reasoning that leads from database to output." He goes on to say that, "the paper trail is crucial if learning is to be possible" since without it, it is "impossible to go back and improve understanding when reality fails to agree with prediction." [75]

The practitioners that we spoke with agreed that it is important to keep a record of what the project has done. As Brian Nyberg of the BC FORESTRY INITIATIVE said, "because people turn over so fast and because a lot of these projects are run by volunteers, we need to have some way of maintaining awareness of the project, its history, and needs for future action. So obviously there has to be some permanent record kept in the local office where the project leadership is housed." In Zambia, Brian Child of the SLAMU PROJECT agreed,

pointing to the extensive plans that each of the communities have developed, saying "it is really important for each group to develop their plan — these things are our collective memories." And likewise, Stephan Forster of the ZAMBIA KANTIPO PROJECT talked about the early days in which the park was being managed without keeping records. As a result, "no one knew where the critical spots were — nothing had been put in a systematic framework."

Although the practitioners that we spoke with recognized the importance of compiling their data and information, they all also said that it was hard to find time to do this work. For example, Charlotte Harland of the ZAMBIA ADMADE PROJECT said that everyone is so busy working that, "Documented learning does not happen much for internal use. Processes are not explained or mandated and things just don't get written down." The practitioners said that part of the solution to this problem is, as discussed above, to collect only the data you need. A second part of the solution is to try to set up effective data management systems. To deal with this problem, three of the projects that we visited have set up extensive computerized databases to store monitoring data. In these cases, however, the data were either not entered into the system, or were not used to their full potential. Dale Lewis of the ZAMBIA ADMADE PROJECT said that the computer was definitely helpful — "with the use of Microsoft Access, it is not so scary to see so much data." He also felt that "When data are in a form that can be used, it's more democratic — everyone has access." But even so, the amount of data threatens to overwhelm the project. As Lewis said, "We keep track of so many questions — then these generate assumptions — these assumptions generate data — data generate assumptions." Robert Bino of the PNG PROJECT agreed, saying, "I think the monitoring system that we set up can become a very powerful tool, but it is not one yet because we are not accessing the data."

Some of the other practitioners we spoke with had not yet set up extensive databases, but talked about the importance of doing so, especially as their organization expands in the future. For example, Brian Nyberg of the BC FORESTRY INITIATIVE described how his central office got lots of information from field offices, saying:

> *What we'd get from them is raw data, lots of information in what we'd call progress reports and other kinds of summaries of their success or their interpretation of what they've done. We certainly talked about the notion of needing a central database and repository for both the raw information itself as well as all the interpretive reports, but we haven't pursued that to any great extent because we've had a relatively small number of projects around the province. It hasn't been so overwhelming that if somebody is looking for information that I would have no idea how to get it to him. If we had a much more comprehensive program across the province, however, there would need to be a much more effective way of coordinating and tracking all the data and the results that are coming out of it. I can see how for any organization that's involved with a lot of projects in a lot of different places around the world, it's valuable to have some sort of a tracking system for keeping that kind of information available and handy and making sure that it's not lost through whatever surprises may happen at the field level.*

STEP E: Analyze Data and Communicate Results

The second to last step in adaptive management involves taking all of the data that you have collected in your databases and turning it into useful information. Many projects collect tons of "ore" that contains "golden information" about what works, what does not, and why. Unfortunately, like real gold ore, this data will not do you any good if you don't purify it to produce concentrated nuggets of information. It also won't do you any good if you only keep the information in your head. If you don't record the information, you will over time forget important details about what you have learned. Furthermore, a lesson stored in your head will generally not be available to other people working on your project either now or in the future. And it certainly won't be available to other people working on similar projects in other places. All too often, it seems that projects generate information, but fail to retain or communicate it.

Analyzing your data on a regular basis enables you to extract the useful information from it. Analysis also enables you to boil down large quantities of information into useful principles. Documenting these findings — writing them down or otherwise recording them — enables you to use them in the future and to share them with other people so they can benefit from your experience.

Most practitioners seem to feel that they are too busy with day-to-day work and problems to analyze and deal with the data that they collect. To overcome this challenge, it is important to find ways to fit analysis and communication efforts into your work plan. This may actually be easier than it sounds. For example, if you have planned your project properly, then much of your documentation should already be completed. Your conceptual model and management plan should contain the questions you're asking, the assumptions you're making, and the interventions you're using to test them. Your monitoring plan should outline what data you have been collecting. And your database should contain the information that you have collected. You thus now only need to interpret what these results mean and then communicate them in a way that addresses the needs of your key audiences.

Analyze Your Data

Analysis is fundamentally a process of transforming raw data into usable information. Analysis is most effectively done in the context of specific questions you are asking or assumptions that you are testing. On one hand, you want to make sure that you are using all the data you have collected and to learn as much as possible. On the other hand, you also want to make sure that you are not trying to conclude more than the data justify. In particular, it is important to try to boil your data down so that you are left with only the most important lessons.

The theoretical sources that we consulted emphasize the importance of the analysis process in producing useful information. For example, Lee describes how adaptive management is fundamentally about obtaining information to improve results. He describes how:

> *Adaptive managers take special care with information. First, they are explicit about what they expect, so that they can design methods and apparatus to make measurements. Second, they collect and analyze*

> *information so that expectations can be compared with actuality. Finally, they transform comparison into learning — they correct errors, improve their imperfect understanding, and change action and plans.*

In a similar fashion, Pirsig discusses how one of the key steps in the scientific process is to "analyze and draw conclusions from the results of the experiment about your hypothesis." He goes on to say that "skill comes in stating no more than the experiment has proved." [76] Pirsig also emphasizes the need to distill your data into general and simple statements. He cites the French philosopher of science Henri Poincaré, saying that what a scientist seeks to do is find the facts that convey the most information. As Pirsig states, "the more general a fact is, the more precious it is." Furthermore, "general facts are also simple...a scientist does not choose at random the facts that he observes. He seeks to condense much experience and thought into a slender volume." [77]

All of the practitioners that we spoke with agreed that analysis is a key step in the overall adaptive management process. As Stephan Forster of the ZAMBIA KANTIPO PROJECT said, "Our assumption was that with more information, we could do better conservation." They also, however, all said that their project faces a number of challenges in doing analyses. One major problem is having too much data flowing into the project office from various field sites. For example, Brian Nyberg of the BC FORESTRY INITIATIVE described how his central office got lots of information from field offices, saying that while they have received lots of raw data in progress reports and summaries, "in terms of using the actual raw data itself, we haven't actually gotten to the stage of doing a lot of detailed statistical analysis yet." In a similar fashion, Robert Bino of the PNG PROJECT said, "I think the monitoring system that we set up can become a very powerful tool, but it is not one yet because we are not accessing the data — we have not yet analyzed that last two years' results." He goes on to say:

> *One of the key challenges of our project is identifying the appropriate analytical tools to employ in evaluating and making a better scientific sense of the data collected. There is the tendency to quickly identify monitoring tools with ease from the outset and not having the foresight to consider and weigh out how the data can be effectively processed for a better appreciation of any trends that may exist.*

To overcome this problem, some of the practitioners we spoke with said that it was important to make sure that local field staff members don't merely record data, but also attempt to process and analyze the information. As Brian Nyberg of the BC FORESTRY INITIATIVE says:

> *We've got to make it clear to people, first of all, what we think needs to be recorded and then give them an appropriate format for it. So we developed a template for project establishment and project plans and another template for progress reports. They just basically have different topic headings and a few details as to what we expect should be included in each one of these things. We then give these templates to everybody who starts one of these projects and say, "This is the model we'd like you to follow." Sometimes they do and sometimes they don't, but at least it stresses the points that we think need to be included, such as the understanding of how the system operates, the model, and who's responsible for doing what over what time schedule or what the uncertainties are that they are trying to address, what the indicator variables are, and so on. So, we give them the templates just to provide some structure.*

The practitioners that we spoke with also agreed that it is important to take large amounts of information and boil them down into simple principles that can encapsulate the lessons learned. For example, Dave Maloney of the BC FORESTRY INITIATIVE told the story of how his office was concerned with the effects of tree shade on the

temperature of small streams used by salmon. Because of this concern, forestry workers were going to each potential timber harvesting site and marking the specific trees along each stream that would need to be cut or left to achieve the proper stream shading. Over time, however, as they analyzed their data, they began to realize that owing to their high Northern latitude, trees on the north side of an east-west segment of stream would have very little effect on the amount of shade reaching the stream. As Maloney put it, turning this learning into a principle, "don't worry about trees on the north side of a stream bank" turned what was an extensive two-person field exercise into a simple one-person office mapping exercise.

Document and Communicate Key Lessons

Once you have analyzed your information, you still need to document your results and communicate them to the people who can use them. To do so, you first need to identify your key audiences — including you and your colleagues, the stakeholders that you work with, your donors and supporters, as well as your peers. For each audience, you then need to think about what information they need and how they want to receive information. The traditional way to communicate information is through a written report. Unfortunately, as we all know, a lot of times project reports seem to pile up on people's shelves without getting read. The challenge is to thus find ways of communicating information that people can use.

The practitioners that we spoke with also agreed that while communicating the lessons that you've learned is an important part of adaptive management, you also have to find a way to do it that is both easy for you to do and meets the needs of your audience. For example, Brian Nyberg of the BC FORESTRY INITIATIVE said, "I think the biggest concern that we have is that because our staff turns over so much and because people are so busy trying to do the day-to-day things that they are expected to do to earn their paycheck, they often don't put the time into documenting." He went on to say:

> *So we should be doing more documentation, no question about it. But again, I can only do so much, so I decided to put the priority on oral presentations and one-on-one discussions and meetings with people and specific project activities and training, as opposed to publication, writing, distribution, and so on. We used to put out a newsletter. In fact, we tried to do it three or four times a year and while Brenda was here, we were on more or less that schedule. Since she left, I haven't even been able to get a new edition of that out, just again because it's nice to do, but it's not the most critical thing to do.*

The practitioners that we spoke with also emphasized the need to not just rely on written reports, but to use other venues for communications. For example, Dale Lewis of the ZAMBIA ADMADE PROJECT said that there can be too much emphasis on trying to write manuals that then quickly go out of date. As Dale said:

> *We train our staff to have knee-jerk reactions to the situation at hand. We don't have rote training programs and manuals. I refuse to. I prefer knee-jerk reactions. We need to base our actions on the knowledge that we accumulate. But my guys are smart — we need to stop writing manuals that are a waste of time. We move much faster than that — it is unimaginative to teach people out of a book.*

To solve this problem, all of the projects that we visited used meetings as a regular method for sharing lessons among project members and community stakeholders. These meetings have the advantage of providing two-way

information flow. For example, Dale Lewis of the ZAMBIA ADMADE PROJECT said, "Workshops and forums are the best way for us to communicate our results to the communities." Stephan Forster of the ZAMBIA PROJECT said "Ideally we do the planning process and feed the results back into our plan. Much of our communication and learning is through our periodic and annual meetings." Similarly, the PNG PROJECT uses both regular staff meetings and an annual meeting among stakeholders to share lessons. As Robert Bino said, "at the meetings, the reports from one community are copied and distributed to RCF people in other communities. At the biannual meetings there is a lot of sharing of experiences." These meetings will only preserve learning, however, if careful minutes of the meetings are kept and are available for staff in the future.

ITERATE: Use Results to Adapt and Learn

Finally, you've come to the last step in the adaptive management process. Despite all the hard work that you have done, this is not the time to sit back and relax. Instead, you have now come to the most crucial step in the whole process. It is now time to use the results of all your hard work. Unfortunately, all too often it seems that project teams don't make use of all the gold that they have mined and refined.

To make full use of your gold, you have to use your results to adapt and to learn. To do so, you have to go back to your original conceptual model and to the assumptions that you laid out and then tested experimentally. If your experiments turn out exactly as you predicted, then you will have confirmed your assumptions — you can now be a bit more confident about them. Chances are, however, that your experiments will not have turned out exactly as you predict. In this case, you need to then use these results to change the actions that you are taking. If your results signal the need to change, by all means, do it. Remember, you collected all those data and information for something, so use them!

You also need to use your results to change your model. By doing so, you will be capturing the learning that you have done and incorporating it into your project's institutional knowledge. You will also probably be initiating a new round of assumptions that you can now start thinking about how to test. In effect, the end of one round of the cycle is also the start of the next round. Over time, you will go through the cycle multiple times, hopefully growing and learning as you do so, and ultimately, leading to better conservation.

Incorporate Adaptation Into Decision-Making Structures

In a conservation project context, adaptation is about systematically using the information obtained through your monitoring to take action to improve your project. If your project intervention did not achieve the expected results, it is because either your assumptions were wrong, your interventions were poorly executed, the conditions at the project site have changed, your monitoring was faulty — or some combination of these problems. Adaptation involves changing your assumptions and your interventions to respond to the new information

obtained through your monitoring efforts. It means staying flexible, examining your past actions, and looking for key opportunities to leverage change.

Many of the theoretical sources that we reviewed strongly emphasized the need to use the results of your inquiry to change. As Pirsig writes, once a motorcycle mechanic has used the scientific method to figure out that his electrical system is not working:

> *He does know that the motorcycle isn't going to run until the electrical system is working and he sets up the next formal question: "Solve problem: what is wrong with the electrical system?" He then sets up hypotheses for these and tests them. By asking the right questions and choosing the right tests and drawing the right conclusions the mechanic works...until he has found the exact specific cause or causes of the engine failure, and then he changes them so that they no longer cause the failure.* [78]

Likewise, Schön writes, the key to reflection-in-action is that the process takes place when it is still possible to take action to change the situation:

> *A practitioner's reflection-in-action...is bounded by the "action-present," the zone of time in which action can still make a difference to the situation. The action-present may stretch over minutes, hours, days, or even weeks or months, depending on the pace of activity and the situational boundaries that are characteristic of the practice.* [79]

Indeed, change is not only desired, it is an imperative in an environment in which the world is changing around us. Senge relates the "parable of the boiled frog" in which if you place a frog in boiling water, it will immediately try to jump out. However, if you put the frog in a pot of warm water on the stove and gradually heat it up, the frog will stay put until eventually it is too groggy to move. As Senge states, "the frog's internal apparatus for sensing threats to survival is geared to sudden changes in his environment, not to slow, gradual changes." [80]

The practitioners that we spoke with also agreed that it is important to use the results of their work to change over time. Dale Lewis of the ZAMBIA ADMADE PROJECT said simply, "That's what we're here for — using data to make decisions." As an example, he described how the project invests in monitoring their teaching programs. They can then adjust the teaching and training based on the results. Similarly, Stephan Forster of the ZAMBIA KANTIPO PROJECT described how, "Based on data we collected and our analysis, we changed our geographic focus — we changed where we work. We found that the more presence we have in an area, the less poaching will occur — simply with our presence."

The practitioners also said, however, that it can be difficult to get people to use information to change — that there is an inertia that keeps people from modifying their actions. For example, the BC FORESTRY INITIATIVE staff describe how they conducted an experiment to see whether wooden bridges or metal culverts were more effective at providing stream crossings for timber trucks with minimal effects on water quality. Based on the experiment, it was pretty clear that the wooden bridges were both "substantially cheaper and more fish-friendly." Nonetheless, it was hard to get the timber companies to switch from the culverts to the wooden bridges. As Brian Nyberg says, this is "partly because of a lack of effort in extension and training" but also partly due to an attitude of not

expecting to use results — in the sense that "well, we've got the results and the question is resolved, so let's get on to the next thing."

One way of overcoming this inertia is to plan from the start how the results will be used in decision-making processes. For experimentation to lead to change, there must be a clear framework and process for decision making, or as Charlotte Harland of the ZAMBIA ADMADE PROJECT said, "When we make decisions, we need to make sure that there is sufficient and good data with an organized decision-making structure rather than 'seat of the pants' reaction to the information."

In the ZAMBIA KANTIPO PROJECT for instance, the project team has organized regular meetings to work with stakeholders to modify the annual work plan. This process is known, systematic, predictable, transparent, and includes a wide range of stakeholders. All stakeholders know what they are going to do with the information generated from experimentation — they know how data can influence the way the project will go in the future — and understand how information will be used for decision making. Likewise, Brenda Taylor of the BC FORESTRY INITIATIVE said how in the initial project workshop, it is important for project teams to ask themselves, "well if we got this result, how would we change?" If people have discussed in advance what they will do if they get one result versus another, then "you can get people to refer back to the discussion when it actually does come to change." But she and her colleagues then went on to say that they had not actually done this — and doubted whether people would make decisions based on a discussion that had been held years ago.

And of course, there is no point in changing just for the sake of change. As Dale Lewis of the ZAMBIA ADMADE PROJECT said, "Once you find things that work you need to stick with them. That is why ADMADE is becoming more structured — we know more about what we are doing."

Use Results to Learn

In a conservation project context, *learning* requires your organization to have a commitment to figuring out how to do your work better and to using and benefiting from your mistakes rather than hiding them. It is also about systematically documenting the process that your team has gone through and the results you have achieved. This documentation will help your team avoid making the same mistakes in the future. Furthermore, it will enable other people in the broader conservation and development community to benefit from your experiences. Other practitioners are eager to learn from your successes and failures so they can design and manage better projects and avoid some of the hazards and perils you may have encountered. By sharing the information that you have learned from your project, you will help conservation efforts around the world.

All of the theoretical sources that we reviewed, emphasized the need to promote learning. For example, for Pirsig, good science is not about achieving positive results, but about expanding understanding. As Pirsig puts it:

> *An experiment is never a failure solely because it fails to achieve predicted results. An experiment is a failure only when it also fails adequately to test the hypothesis in question, when the data it produces don't prove anything one way or another.* [81]

The key here is to start with the vast body of information that is already known and to try to move the frontier forward — adding another brick to the pyramid of human knowledge. Pirsig goes on to describe how the primary work that a motorcycle mechanic does involves constructing and testing mental models to expand learning:

> *Actually, physical labor is the smallest and easiest part of what the mechanic does. By far the greatest part of his work is careful observation and precise thinking. That is why mechanics seem so taciturn and withdrawn when performing tests. They...are concentrating on mental images, hierarchies, and not really looking at the physical motorcycle at all. They are using the experiment as part of a program to expand their hierarchy of knowledge of the faulty motorcycle and compare it to the correct hierarchy in their mind. They are looking at underlying form.* [82]

In an organizational context, one of the key premises behind the social learning concept is that learning does not just occur to solve immediate problems. Instead, learning should be aimed at trying to solve more long-term problems. This more long-term learning can only take place if it is incorporated into the group's organizational maps. Argyris and Schön state:

> *Organizational learning occurs when members of the organization act as learning agents for the organization, responding to changes in the internal and external environments of the organization by detecting and correcting errors in organizational theory-in-use, and embedding the results of their inquiry in private images and shared maps of organization.*

Argyris and Schön go on to say that there are two types of learning:

> *When the error detected and corrected permits the organization to carry on its present policies or achieve its present objectives, then that error-detection-and-correction process is single-loop learning. Single-loop learning is like a thermostat that learns when it is too hot or too cold and turns the heat on or off. The thermostat can perform this task because it can receive information (the temperature of the room) and take corrective action. Double-loop learning occurs when error is detected and corrected in ways that involve the modification of an organization's underlying norms, policies, and objectives.* [83]

In effect, double-loop learning involves not only dealing with the situation at hand, but also changing the very fundamental ways in which the organization functions, so as to be able to deal with other similar situations in the future. Adaptive management is fundamentally about double-loop learning.

The practitioners that we spoke with emphasized the importance of learning. For example, Robert Bino of the PNG PROJECT described how he used to live and work in the village, but had recently been promoted and was now living in the town. As a result, he said he needed to find ways of sharing what he learned so that the project could avoid making all the mistakes he had made. As he said, "many people are very interested in the way that we have combined conservation and development...we really need to make sure that we make this knowledge available for ourselves and for the wider community." In a similar fashion, Brian Nyberg of the BC FORESTRY INITIATIVE said "adaptive management is a systematic process that involves continually improving management policies and practices by learning from the outcomes of operational programs." But perhaps this thought is most eloquently summed up by Dale Lewis of the ZAMBIA ADMADE PROJECT who said "adaptive management should

become the common standard. The basic idea behind it is so simple that it is hard to argue with it. Even if you don't do it perfectly, it is hard to argue that you shouldn't learn."

Keep Going Through the Cycle

Perhaps the most important point to keep in mind as you go through the preceding steps is that you don't just go through the cycle once. Instead, as shown in Figure 2, you need to go through the steps in the cycle over and over again. The key to adaptive management is that it is an ongoing and iterative process. You develop a model and experiment with an action and collect and analyze data about this action. You then use the results to modify your model and to suggest new actions. You then collect and analyze data about these new actions, and use them to adapt and learn again. Each pass through the cycle will hopefully enhance your ability to do effective conservation.

The theoretical sources that we reviewed agreed that learning is an iterative process. Pirsig describes how at its core, the scientific method involves weaving together two kinds of logic. *Inductive inference* involves starting with observations of the natural world and then arriving at general conclusions based on these observations. Induction is thus reasoning from particular experience to general truths. *Deductive inference* involves starting with general knowledge and predicting specific results. Deduction is thus reasoning from general truths to particular experience. The scientific method involves combining long strings of mixed inductive and deductive inferences over time to build up our understanding of the natural world. [84]

In a similar fashion, for Schön, reflection-in-action is not a one-time event. Instead, it is part of an ongoing two-way dialogue between the practitioner and the system he or she is working with. In effect, the practitioner is shaping the situation through his or her actions, but is also modifying and shaping his or her understanding of the world as a whole. Schön speaks of this as a conversation between the practitioner and the problem:

> *In the reflective conversation, the practitioner's effort to solve the reframed problem yields new discoveries which call for new reflection-in-action. The process spirals through stages of appreciation, action, and reappreciation. The unique and uncertain situation comes to be understood through the attempt to change it, and changed through the attempt to understand it.* [85]

The practitioners that we spoke with echoed this sense of an ongoing iterative process of going through the steps of adaptive management. As Brian Nyberg of the BC FORESTRY INITIATIVE said in talking about the cycle that they use:

> *If somebody is doing adaptive management, then they have to be doing all of the steps in the cycle over and over again...if people are not doing all of these steps, they really aren't doing adaptive management. If you're just doing monitoring alone, or planning and modeling alone, they are useful, but on their own, they are not adaptive management.*

The practitioners also emphasized, however, that in real life this process is never quite as neat and clean as when laid out in a guide like this one. For example, Brenda Taylor of the BC FORESTRY INITIATIVE said:

> *I guess when you lay out the procedure, it's always very clean in the way you do step one and then step two and step three and step four. When you think about it in your mind it's clean that way. But, when you actually come down to doing it, I guess I get frustrated, it's never that clean. It's always kind of nasty and you're always juggling how much time do you devote to different things. It's really iterative. Nothing ever seems to go according to the kind of template or the ideal case, that goes through all the steps really cleanly. In reality it's messy.*

PRINCIPLES FOR THE PRACTICE OF ADAPTIVE MANAGEMENT

IN THE PREVIOUS SECTION, WE DISCUSSED the specific steps involved in the practice of adaptive management. In this section, we outline eight principles that you should keep in mind as you go through these steps. Each principle describes a characteristic of an individual, project, or organization that we believe contributes to effective adaptive management. These principles are:

Principle 1: Do Adaptive Management Yourself

Principle 2: Promote Institutional Curiosity and Innovation

Principle 3: Value Failures

Principle 4: Expect Surprise and Capitalize on Crisis

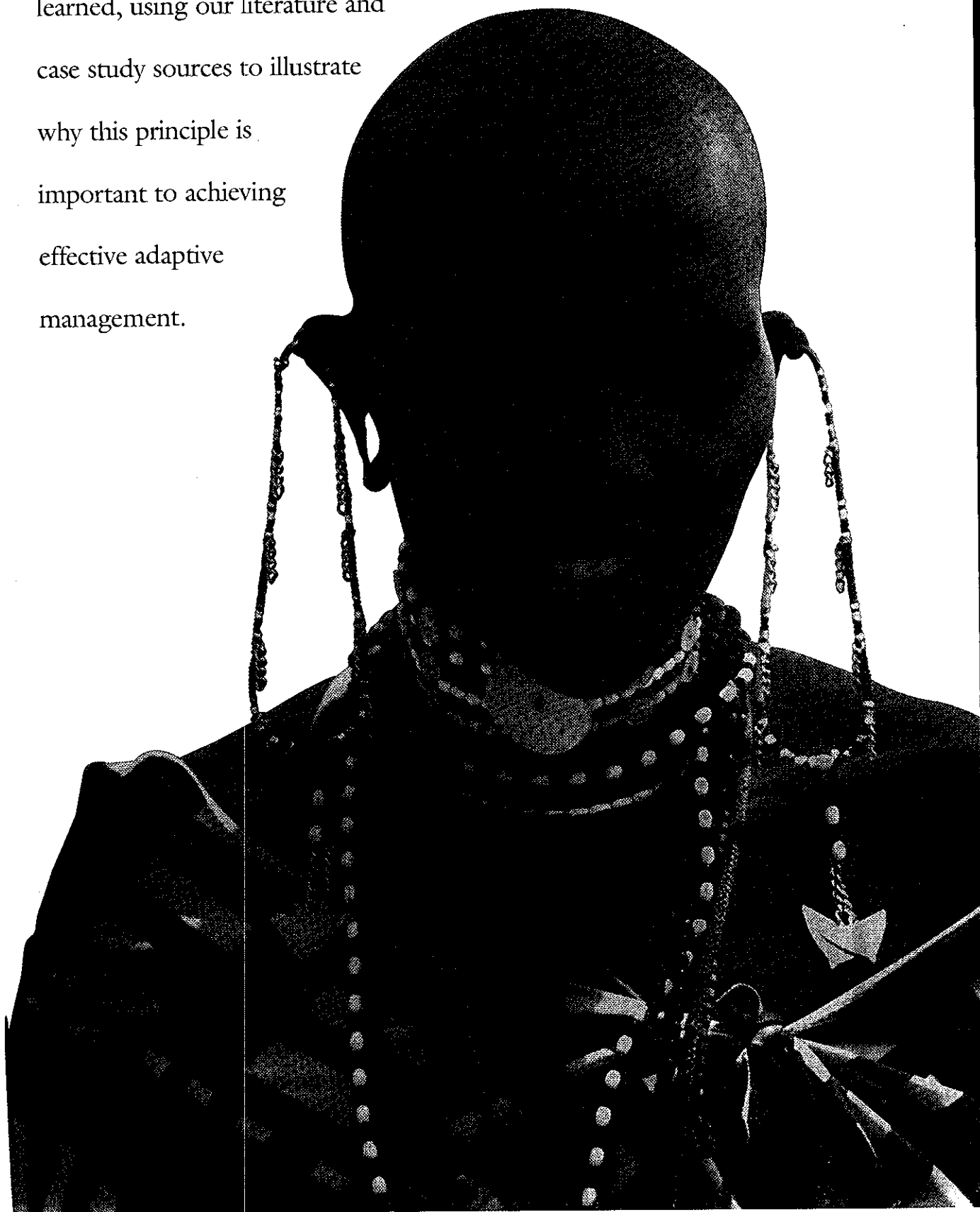
Principle 5: Encourage Personal Growth

Principle 6: Create Learning Organizations and Partnerships

Principle 7: Contribute to Global Learning

Principle 8: Practice the Art of Adaptive Management

For each of these principles, we first discuss what the principle means in the context of conservation. We then lay out some of the key things that we learned, using our literature and case study sources to illustrate why this principle is important to achieving effective adaptive management.



Principle 1: Do Adaptive Management Yourself

Perhaps the most important principle is that project team must be responsible for performing effective adaptive management. All too often, it seems that either an external consultant or a member of the lead organization who is based in a headquarters office designs conservation projects. These outside people go through some of the planning steps discussed in the previous section such as doing a site assessment and developing management and monitoring plans. They then turn the plans over to the project team on site to implement them. One obvious problem with this external based design process is that the outside designers may not be fully aware of the complexities of the situation at the project site. As a result, the project may not fit with local conditions.

From an adaptive management perspective, however, a more troubling problem with the standard approach is that because the project team was not involved in the design of the project, it may be hard for them to feel ownership over the project. In particular, the project team will have little knowledge of the assumptions and ideas that lie behind the project. As a result, they may not be able to implement the project in the way that the designers intended. More importantly, it becomes difficult for the team to change the plan in any systematic way. And it becomes hard for them to do any learning under these conditions.

To solve these problems, it is imperative that the project team members go through the steps in the adaptive management cycle themselves. Adaptive management cannot be left solely to outside experts that are not involved in project management. It also cannot be delegated to a special research team that is solely charged with looking impassively at the potential project outcomes while the rest of the team sits around waiting for their results. The team may need to get some advice or assistance from outside sources, but ultimately they need to do the work themselves. You and your colleagnes are the researchers. You are responsible for testing your own assumptions and for using and learning from the results.

Involve Regular Project Staff Members

A number of the literature sources that we reviewed emphasized the importance of having regular program staff conduct adaptive management. As Kai Lee says:

> *For a policy to be an experiment, regular program staff must carry out major portions of the experimental protocol...if a change is to be made as a result of lessons learned from the experiment, the acceptability of that change to those who must implement it is likely to be heavily influenced by their memory of the experiment and how it was carried out.* [86]

In a similar fashion, Norm Bilodeau of the BC Forestry Initiative believes that since he is the resource manager, he is also ultimately responsible for designing the adaptive management process. He often consults with various experts, but that "somewhere in the research process, you need to have somebody like me that's sort of a generalist — someone who is not a master of all the specialties, but has an overall perspective." He went on to say

that having the resource manager design the process is key so that the specialists don't get off track by focusing on their particular specialty. As the resource manager, he can tell the specialists that what they advocate "has to make sense to me." John Ericho of the PNG PROJECT agreed, saying that "the key aspect of this process is that we as project staff are doing it — because we understand it, we are able to go back and say this is not right, I think we should do this other thing instead."

Help People Learn About Adaptive Management

Although the concept of having a project team doing adaptive management sounds good in theory, getting a team to fully participate in the process may be easier said than done. It may be hard to get people unfamiliar with the concept to pay attention to a process that they might not understand until they can see the relevance of the situation for themselves. Kai Lee describes how one potential problem in getting regular staff to carry out adaptive management experiments is that, "They may not know what they are doing and bungle the task, or they may know and subvert it instead." Lee goes on to say, "The key point is to realize that human beings living and working in an operational environment, who do not see themselves as researchers or guinea pigs, are being asked to be one or both." As a result, gaining their confidence is "a precondition for training staff in their research tasks." [87]

John Ericho and Robert Bino of the PNG PROJECT echoed these comments when they told the story of how they gave the conceptual model they developed to newer project members. John started by saying, "I think that the conceptual model is possibly mostly completely understood by just the two of us. I really don't think that the new staff members completely understand it at some levels." Bino added, "I think that after they have been in the field, they understand. Not when they first come to the project. When then they go out in the field, then they say 'Oh — So this is what we do.' They don't really appreciate the model until they are immersed in the scenario."

Principle 2: Promote Curiosity and Innovation

Effective adaptive management fundamentally requires that you have a sense of wonder about how things work and a willingness to try new things to see whether they are more effective. Both curiosity and innovation are basic human traits — as children, all of us investigated our world and tried out different activities. Although things did not always work as expected, we usually learned from the experience.

Unfortunately, curiosity and innovation are not things inherently found in many organizations. As they grow, organizations tend to become more bureaucratic and less flexible. They develop set systems and ways of doing things. As a result, curiosity and innovation are not valued, and may even be discouraged. Spending time wondering about how things work can be perceived as wasteful daydreaming. It becomes safer for employees to use an existing procedure rather than try something new.

To overcome this tendency, for an organization to truly promote learning, it must actively maintain an environment in which staff members are free to explore new ideas and ways of doing things. A common feature of organizations that exhibit "institutional curiosity" is that they continuously question the efficiency, effectiveness, and appropriateness of the projects they implement — they do not simply assume that what they are doing is always right. It also requires that they value the learning that comes from trying new interventions instead of only trying to achieve short-term results.

Innovate to Survive in a Changing World

The business and organizational management sources that we reviewed emphasize that organizations must maintain institutional curiosity to survive in a competitive marketplace. If an organization does not value curiosity and innovation, chances are it will become stagnant, set in its ways, ineffective, and eventually, overtaken by its competitors that do innovate. For example, Senge quotes the head of planning for a major corporation who states, "The ability to learn faster than your competitors may be the only sustainable competitive advantage." Senge goes on to say, "as the world becomes more interconnected and business becomes more complex and dynamic, work must become more 'learningful.'" [88]

All of the conservation practitioners that we spoke with agreed that promoting institutional curiosity and innovation are important for dealing with complex and changing situations. For example, Stephan Forster of the ZAMBIA KANTIPO PROJECT described how "in a dynamic situation, everything changes so you must maintain institutional curiosity. There are new challenges all the time, and you must always be asking 'Why?'" In a similar fashion, Brian Nyberg of the BC FORESTRY INITIATIVE said:

> *I think a lot of even senior field-level managers who have come up through the command-and-control stream in the old days now are under so much pressure and have so many problems facing them that they don't have easy solutions. Even they realize that curiosity and learning is something that is important.*

Start with Managers at the Top

If an organization is going to be curious and innovative, then this attitude has to come from the top. As Senge writes, the manager is no longer the "captain of the firm" issuing absolute commands. Instead:

> *The essence of the new role...will be what we might call manager as researcher and designer. What does she or he research? Understanding the organization as a system and understanding the internal and external forces driving change. What does she or he design? The learning processes whereby managers throughout the organization come to understand these forces.* [89]

The practitioners that we talked to also felt strongly that it is important for managers to encourage their staff members to explore new ideas and ways of doing things. As Brian Nyberg of the BC FORESTRY INITIATIVE stated:

> *Whenever an institution makes a commitment to adaptive management, there has to be a serious commitment from top people. It is important to make people involved in adaptive management projects feel that they are free to innovate. In this situation this is best served by having a manager who tells people that they must be free to think outside the box.*

Obviously, as Nyberg said, you "can't legislate curiosity, but you can encourage it." Instead, he believes that you have to give people the proper incentives — that "thinking outside the box should be built into performance evaluations." He went on to say, "I don't believe that having a top-down directive that 'You will be innovative and do adaptive management' is of much help either unless there is a lot of support provided from the ground up and leadership from top down."

The ability of a manager to promote curiosity and innovation is not only affected by the culture of institution they are working in, but also the culture of the overall society. For instance, many conservation and development projects take place in cultures in which there is traditionally a great deal of respect for authority. This tendency can make it difficult for younger and lower level staff members to try to offer their own ideas instead of trying to tell the boss what they think the boss wants to hear. For example, John Ericho of the PNG PROJECT said:

> *Sometimes it is hard for me to get people to talk because I'm the boss. People just want to listen to me and they say to themselves "ok, so he knows better than I do, so I will keep my big mouth shut." And so that's something that we are having to work around to promote staff participation and contribution. Where people are afraid to speak, we need to make it an environment where they can talk.*

Ericho also feels that part of this difficulty in encouraging innovation may come from the cultural emphasis on maintaining personal relationships. As he said, "Here in PNG we are worried less about results and thinking more that 'I must not hurt the relationship.' So I might be thinking about new ideas but choose not to discuss them with my boss because I think to myself 'man, if I discuss them with him, is he going to get cross with me?'" Finally, Ericho feels that some of the team building work that RCF is doing may also ironically discourage creativity. As he said:

> *We tried to build a team spirit here where everyone is working together. I think this has been counter-productive in terms of speaking your mind because we built the team spirit so much that people don't want to get out of line by asking too many questions or by saying something different to what everyone has been saying.*

Principle 3: Value Failures

Effective adaptive management also requires that you value failure instead of being scared of it. Fear of failure stops us from trying risky things. If you are scared of falling, you may never try to ride a bicycle because you know you will fall off the first few times you try. If you are ashamed of falling, you may not stop to think about why you fell and learn from your mistakes. You may also avoid discussing your experiences with more experienced cyclists. Valuing failure does not mean that failure is desired — falling off a bicycle hurts and causes delays in reaching your short-term destination. In the long-run, however, people who are willing to fall a few times while learning how to ride a bicycle will reach future destinations faster than those who are not willing to fall and must walk everywhere they go. A willingness to fail is thus an indicator that you are pushing yourself to get better.

Many projects and organizations seem to be like the person scared to ride a bicycle for the first time. Under pressure to achieve short-term "results," failure is seen as something to be avoided at all costs. Accordingly, risky activities are not undertaken. Furthermore, when (as is inevitable) things do fail, great effort is expended to cover-up the failures and pretend they never happened. As a result, no learning occurs and people keep making the same mistakes over and over again.

It is also important to create environments in which the risk of failure is lessened. Going back to our example of the new bicyclist, it would not be a good idea to have a novice rider learn to ride on hard bumpy terrain. Instead, we should try to pick a soft place where the rider can fall with minimal pain and maybe even give the rider a helmet. In a similar way, projects and organizations can provide a setting in which their staff members feel secure about sharing their failures. Without this safe-fail environment, free from the fear of punishment, people may feel cautious and unwilling to take risks or share what they have learned the hard way.

To overcome this tendency, it is important for a project or organization to embrace failure rather than try to hide it. Failure should not be valued as much as success, but neither should it be hidden if it can be put to good use — that is, if it is used as a learning experience. It also requires organizations to create an environment in which project team members have the security to take risks and learn from failures.

Learn from Your Mistakes

The literature sources that we reviewed emphasize the need to value failure in order to promote learning. In effect, they state that it is important not to hide failures, but instead to learn from them. As Pirsig puts it:

> *An experiment is never a failure solely because it fails to achieve predicted results. An experiment is a failure only when it also fails adequately to test the hypothesis in question, when the data it produces don't prove anything one way or another.* [90]

In a similar fashion, Lee says that if an implemented policy fails, "an adaptive design still permits learning, so that future decisions can proceed from a better base of understanding." [91] Senge echoes this when he says, "failure is an opportunity for learning (about inaccurate pictures of current reality, about strategies that didn't work as expected, about the clarity of the vision." [92] He goes on to quote one business manager as saying "the hallmark of a great organization is how quickly bad news travels upward." [93]

All of the practitioners supported agreed with the importance of recognizing failures. Perhaps Brenda Taylor of the BC Forestry Initiative said it most succinctly when she described true failure as "Not taking advantage of opportunities and not learning from something — that true failure occurs when you fail to learn." In a similar vein, her colleague Brian Nyberg stated:

> *We have to accept the fact that we are probably not going to achieve exactly what we wanted, and some people may call that failure. If you deliberately try two or three different things, somebody is going to be able to say that one of them, at least, was a failure. But if you learn from it and especially if you can share evidence with other people and show them why one thing worked and another didn't, then that's not a failure by any means.*

Create a Safe-Fail Environment

The literature sources that we reviewed emphasized the importance of creating an environment in which employees know they will not be "blamed" or "punished" if something goes wrong. According to Senge, leaders intent on creating a learning organization must:

> *Work relentlessly to foster a climate in which the principles of personal mastery are practiced in daily life. That means building an organization where it is safe for people to create visions, where inquiry and commitment to the truth are the norm, and where challenging the status quo is expected — especially when the status quo includes obscuring aspects of current reality that people seek to avoid.* [94]

The practitioners we spoke with largely agreed that it is important for organizations to create an environment in which failure is not hidden. For example, Brian Nyberg of the BC FORESTRY INITIATIVE said, the key is that "When we don't really know what we're doing, we should be prepared to admit that freely and openly, and then also make a commitment to learn how to do better. These two things go hand-in-hand and are a way of building trust and support and acceptance that we'll never get if we just try to pretend that we know what we are doing." Likewise, his colleague Norm Bilodeau talked about how he had the ability to conduct his experimental work even in the face of budget cuts because of the support he had from his bosses, "There was pressure there, I guess. The compliment to my bosses would be that they were willing to work with the risk given that I had a good track record, and so they were willing to ride the storm." He goes on to say:

> *Interestingly, I think adaptive management provides a process for institutionalizing change and innovation. It is almost as if the adaptive management process absorbs many of these perceived risks by incrementalizing it and providing an acceptable context that actively encourages problem identification.*

The practitioners also said, however, that creating this environment is not always easy. Dale Lewis of the ZAMBIA ADMADE PROJECT described how difficult it can be to expose your failures in an environment in which you are competing with other projects and are being judged on results:

> *When you are competing for funds, you tend to be less honest and willing to expose yourself. Trying to hide your weaknesses is dangerous. You end up needing to separate your thinking — on one hand playing politics, the other doing good science. I'd like to think I can do both. If you go down just one road, you lose. You have to fight — there are people out there who will mess you up. At the end of the day you are judged on results. To play politics, you need to hide mistakes — that's what it takes. But to learn, you need to look at them out in the open.*

John Ericho of the PNG PROJECT described some of the challenges that he faced in getting national staff at RCF to speak up at meetings because the national staff were worried about speaking up in front of the expatriate staff who they perceived to be the experts. RCF ended up holding some meetings with just national staff to try to give them an environment in which they conld speak up. As Ericho says, "When the expatriate staff are there, people don't talk since they are afraid that they might say the wrong thing, thereby inviting criticism. What I'm trying to do is get people to talk among themselves and express themselves in a comfortable setting. People can be afraid to speak — we need to make an environment where they can talk."

Principle 4: Expect Surprise and Capitalize on Crisis

Effective adaptive management also requires that a project or organization both expect the unexpected and be prepared to act quickly during periods of turmoil. Expecting surprise may sound a bit paradoxical. Yet although surprise may not be something you can really plan for, it is something you can anticipate and be open to. No matter how well we plan, in complex systems things will almost always work out different than expected. One of the keys to conducting a good experiment is being open to any results that may occur, even if they challenge deeply held beliefs. Often it is the strange and surprising results that will lead to new insights and understanding, but only if you are willing to look for them.

Big surprises can often lead to major crisis situations that occur when people lose confidence in the system. Although crisis situations can be difficult, they also present opportunities. When things are going well and there are no pressing problems, people generally have little interest in change. But when there is a crisis, people are often motivated to take immediate and decisive action to remedy the situation. If you are prepared to act, crisis situations can thus be important opportunities to make lasting changes in a system. In times of crisis, the latitude to try new things and fail is greater than under normal conditions. This usually means that people are more willing to take risks as the potential benefits outweigh the potential cost of inaction. During crises, new ideas may emerge that can form the basis for an organization to develop new activities, strategies, and directions.

All too often, however, it seems that conservation project teams try to avoid surprises and ignore observations that might contradict established doctrines. Likewise, most conservation projects are constantly facing crisis situations. These situations can be caused by external sources such as droughts, hurricanes, earthquakes, and other natural disasters, wars, *coups d'etat*, and other political problems, and recessions and other economic problems. Or they can be caused by internal sources such as losses of funds or management transition problems. Unfortunately, in many projects and organizations, there seems to be a tendency to try to ignore or run away from these crisis situations.

If, however, a project or organization expects surprises and is prepared to make use of crisis, then these moments can actually provide opportunities for major changes and growth. It is at these times that project management is the most challenging, but it is also during these critical times that effective leadership, vision, and judgment come to light. If you are prepared to act during a crisis, you may be able to advance a new idea or project that will ultimately be more stable and effective.

Use Surprises to Point to Flaws in Your Understanding

A common feature of the literature sources that we reviewed is that they expect surprising results to occur. As Holling states, "the unexpected can be expected." Owing to the interaction between irregular cycles and the non-linear nature of many relationships, ecological systems may appear to behave according to one set of rules, but may

suddenly flip into a radically different state. For example, a fishery may currently yield a constant supply of fish, yet be on the verge of precipitous collapse. Traditional methods of monitoring or assessment can misinterpret these shifts and make them seem unexpected or perverse. Yet these surprises can also be viewed as clues that can point to a new way of looking at the system. Pirsig writes:

> *In a laboratory situation, when your whole procedure goes haywire, when everything goes wrong or is indeterminate or is so screwed up by unexpected results that you can't make head or tail out of anything, you start looking laterally...lateral knowledge is knowledge that's from a wholly unexpected direction, from a direction that's not even understood as a direction until the knowledge forces itself upon one. Lateral truths point to the falseness of axioms and postulates underlying one's existing system of getting at truth.* [95]

In a similar fashion talking about professional practice, Schön states:

> *The practitioner allows himself to experience surprise, puzzlement, or confusion in a situation which he finds uncertain or unique. He reflects on the phenomena before him, and on the prior understandings which have been implicit in his behavior. He carries out an experiment which serves to generate both a new understanding of the phenomena and a change in the situation.* [96]

Many of the practitioners that we interviewed agreed that surprise is a common feature of their project and a catalyst for change in their understanding of the system. For example, Doug Steventon of the BC FORESTRY INITIATIVE described how he and his colleagues "had a little biological surprise" when their data showed them that certain bird species that they were concerned about actually ended up being more abundant in timber plots that were partially cut. Likewise, Stephan Forster of the ZAMBIA KANTIPO PROJECT told us:

> *We had some big surprises. The whole concept of poaching that we originally held was wrong! We thought that poaching was being driven by the big shot who has guns and who would pay villagers to get meat in combination with locals hunting "meat for their pot." But we found that this doesn't exist. Instead, to our surprise, most poaching was done as a household activity to make money out of the meat. So, we totally shifted our approach — cash became the issue — and agricultural support at the household level became the major activity of our community-based program.*

Likewise, John Ericho of the PNG PROJECT described how in their project, they initially assumed that local people's need for cash was the most important factor driving their decisions. As a result, the project tried to develop enterprises to help people raise cash. Over time, however, they discovered that "the surprise was that we thought cash was the biggest need in the community and it wasn't." Instead, they found that people were after things like "self-esteem" and the "development that comes from things they can see and identify with." They found that what people wanted most was to be connected to the outside world — that once the villagers had guesthouses, they could "strut around with a worldly look." Once the project team caught onto this surprise, they began to modify their project plans and the activities that they were undertaking.

Use Crises as Opportunities for Action

If there is a major surprise, it can lead to a crisis situation in which existing theory crumbles and there is no guidance for action. Many of the literature sources that we reviewed state that it is precisely during these crisis

situations that it is possible to take high leverage actions. Kuhn, for instance, believes that major revolutions in scientific thinking come about during crisis periods when established theories all of a sudden no longer seem to work. He cites as an example the observations of "inconsistent" movements of the planets that contradicted the path that would be expected if they orbited the earth as described by the prevailing theory. These observations led Copernicus to reject this long prevailing theory and propose instead the theory that the earth and planets orbit the sun. Similar revolutions also occurred in chemistry before the discovery of oxygen by Priestly and Lavoisier and the development of the theory of relativity by Einstein. As Kuhn writes, "In each case, a novel theory emerged only after a pronounced failure in the normal problem-solving activity...the novel theory seems a direct response to crisis." [97]

In a similar fashion, Holling describes a four-phase cycle that ecosystems go through.[98] There is typically a slow building phase in which the system builds up capital such as stored nutrients and also becomes more complex. This steady growth plateaus during a climax or conservation phase. The system is then suddenly transformed during a crisis or release phase such as during a forest fire. Following the crisis, there is then a reorganization phase during which the system can return to its former starting point — but also can flip up or down to a different plane in terms of the available capital. The key point in this model is that the leverage to truly impact the system comes during the critical revolution during the crisis and reorganization phases. Resource managers should be prepared to take action during crisis periods that occur when the existing policies are recognized clearly as no longer being adequate — in effect, "to learn to manage by change rather than simply to react to it." [99] Although this model was originally developed to describe ecosystems, Holling and his colleagues soon realized that it could also be applied to the cycles that organizations and societies go through. For example, organizations often go through periods of steady growth that are suddenly shattered by a crisis caused by cutoffs in funding or a leadership transition. Likewise, peaceful societies can be suddenly transformed into unstable ones by crisis situations caused by natural disasters, political turmoil, and economic problems. These crisis periods provide important opportunities to leverage change within the system. An individual within an organization or a group within a society that may have no hope of impacting the system during the slow exploitation and conservation phases may suddenly get their chance during the release and reorganization phases — if they are prepared and ready to act. [100]

Few of the practitioners that we talked with could identify major crises in theory that had emerged in their work in the sense that Kuhn talks about it. However, all of the projects frequently faced crisis situations of the type that Holling describes — as Norm Bilodeau of the BC FORESTRY INITIATIVE said, "We thrive on crises."

In some cases, these crises were triggered by external events. For instance, the ZAMBIA ADMADE PROJECT faced a series of food shortages in the country that forced them to look at sustainable agriculture as a way to address community needs that were causing poaching. Likewise, the BC FORESTRY INITIATIVE staff described how the provincial government faced massive budget restrictions as a result of the Asian economic crisis and the resulting reduced demand for forestry products. Norm Bilodeau described how the crisis provided a good opportunity to demonstrate to senior management how the planning that they were doing, as part of their adaptive management

regime, allowed them to work in a much more flexible and efficient manner, absorbing the budget losses by adjusting harvesting plans to reduce road construction requirements.

In other cases, these crises were triggered by internal events occurring within and between the different stakeholder groups involved in the project. For example, the ZAMBIA ADMADE PROJECT initially had decided to work with local chiefs to help implement projects because they held the most power in the communities. A minor crisis developed when it became apparent that some of the chiefs were corrupt. As a result, the project moved to creating Community Resource Boards that ended up being much stronger in the long term. In a similar fashion, the PNG PROJECT went through a crisis period during a leadership transition problem. As John Ericho states, this "crisis was a blessing in disguise" in that in solving it, they were able to restructure the organization in a more effective manner. Another crisis that this project faced was when some of the local leaders in the villages where the project was taking place planned in secret to evict the project from the area on the basis that they hadn't delivered any tangible goods. During this developing crisis, one of the local clans came out in public and said they would "defend RCF with their lives." This was an important statement that solidified long-term support for the project.

Principle 5: Encourage Personal Growth

Ultimately, projects and organizations are only composed of people. So clearly, effective adaptive management requires people who have the necessary skills and experiences. It also requires individuals who have a commitment to personal growth and learning. Unless the people in the organization learn new skills and gain new experiences, it is highly unlikely that the organization will grow.

Most conservation projects and organizations are under severe pressure to achieve substantial results with limited staff and money. As a result, there can be a tendency to use all available resources to deal with short-term problems. Unfortunately, this tendency often means that projects hire the nearest available person to solve a particular problem. And it means that they do not invest in helping this person learn and grow over time.

To conduct effective adaptive management, a project or organization has to hire people who are committed to learning and growing. It also must invest in giving these people the resources, motivation, and most importantly, time to develop new skills and knowledge. Investing in staff can be expensive in terms of the upfront costs required as well as the time away from their regular work. But this investment should pay off in terms of more productive and invested staff members.

Hire People Who Are Committed to Learning

Several of the business and organizational management sources that we reviewed emphasize personal growth. For example, Argyris and Schön write, "Organizational learning is not merely individual learning, yet organizations learn only through the experience and actions of individuals." [101] In a similar fashion, Senge extensively discussed

his discipline of developing "personal mastery." Personal mastery does not mean gaining dominance over things, but instead demands a commitment to lifelong self-learning. According to Senge, ultimately organizational learning depends on individual learning since "organizations learn only through individuals who learn. Individual learning does not guarantee organizational learning. But without it, no organizational learning occurs." [102] Senge goes on to say, "the organizations that will truly excel in the future will be the organizations that discover how to tap people's commitment and capacity to learn at all levels in an organization." Furthermore, this learning can never cease:

> *To practice a discipline is to be a lifelong learner. You never arrive; you spend your lifetime mastering disciplines. You can never say, "We are a learning organization" any more than you can say, "I am an enlightened person."* [103]

The practitioners that we spoke with agreed that personal learning is critical to good adaptive management — and ultimately to conservation success. In particular, the conservation groups we spoke with discussed the challenges that they faced in finding trained staff given the relatively low wages and benefits they can pay compared to the private sector. One way around this challenge is to hire staff who may have less experience but who are committed to both conservation and especially to learning. For example, the PNG PROJECT hires people with a business background to help them run their eco-enterprises. But they also want to find people who are good learners so they can learn about conservation. As Robert Bino said, the key is "how our business people learn. And now that I think about it, I am amazed at what they seem to learn about conservation." Norm Bilodeau of the BC FORESTRY INITIATIVE proudly said, "I've been a life-long tinkerer and learner." He went on to say "I've spoken to lots of professionals who tell me 'I went to a university to do my learning — why do I have to read all that stuff now?'" Bilodeau said when he hears this, "my jaw just kind of drops."

Invest in Helping Staff Develop Skills and Experiences

The literature sources that we reviewed also emphasized the need for projects and organizations to invest in their staff to help them develop their skills and experiences. Senge writes that to promote personal mastery, an organization must "continually reinforce the idea that personal growth is truly valued in the organization" and it must "provide on the job training that is vital to developing personal mastery." Senge also cautions, however, that this training must be voluntary, saying that "compulsory internal personal growth training programs" are "probably the most sure-fire way to impede the genuine spread of commitment to personal mastery in an organization." [104]

Although the practitioners that we spoke with recognized the need to help their staff members develop new skills, they also emphasized that this requires a substantial investment in terms of both money and short-term opportunity costs of staff time. For example, John Ericho of the PNG PROJECT team described how they created a staff development program. As he said, "We allow staff members to do evening studies now. For example, our accountant is enrolled part-time studying at the University of Technology to improve his skills. And we're

thinking about sending our Education Officer to India where she'll receive specialist training in conservation education." These training sessions obviously require substantial investments from the organization. Ericho said the key is that staff members have to be motivated and propose the training themselves:

> *We tell them, 'It's up to you, you take the initiative. If there is a workshop that is coming that is useful, let us know — we have only so much money each year for staff development — but we will see if we can assist you to the to improve your skills so that you can become a better person giving us high productivity.'*

Traditionally, one of the challenges of providing individuals training is that once people receive training, they can leave the organization, taking their new skills with them and leaving the organization back where it started. Although this loss can be frustrating, the key is to view this as a long-term investment in the overall skill level of the society. As John Ericho of the PNG PROJECT said, "if people move on after training, we still think that it's not a loss...we're a training ground for conservation personnel in this country so it's not a loss to us as much as it's a gain to the country. So, we are happy to serve as a training ground for the good guys." Even someone who goes on to an oil company or forestry company may over time end up in a position of power and may remember their conservation experience and be a friend you can go to in a decade or two.

Principle 6: Create Learning Organizations and Partnerships

Effective adaptive management requires projects and organizations to capture the learning that individuals develop so that it can be used in the future. You may feel that the problems and issues that you deal with on a day-to-day basis are too trivial for anyone else to be interested in. Think back however, about what you know now relative to what you knew when you started your career. It probably would have been helpful to know then what you know now. Since you and your colleagues will not be with a project or organization forever, it is important to transfer your knowledge so that future staff members can benefit from your experiences by capitalizing on your successes and avoiding the mistakes that you made. Since most projects are implemented by alliances of different partners, it is also important to make sure that knowledge gets transferred to your partners — and that you get and use knowledge from them.

Projects and organizations are constantly changing in structure, staff, direction, and orientation. All too often, it seems that when new staff members come on board, they end up having to relearn everything and end up making the same mistakes over and over again. It also seems to be common for one group participating in a project to learn something, but not transfer the knowledge to their partners.

To overcome these problems, it is important for projects and organizations to develop ways of getting information and experiences out of the heads of individuals and into the "collective memory" of the group. Projects and organizations that are serious about learning invest in both creating documents that record their history and in

using them. Effective projects and organizations also make sure that they share information with their partners, knowing that if they get too far ahead of them, ultimately they will not be able to work together in an effective fashion. And, of course, your partners may also have a lot of information that would be helpful for you to have access to.

Promote Organizational Learning

All of the adaptive management sources that we reviewed agreed on the importance of promoting organizational learning. Institutions are formed by groups of people who by working together, can accomplish more than they can on their own. As Lee says:

> *No person, however visionary, however powerful, can live and exercise power long enough to steer the world economy from where it is now headed onto a stable long-term course...if there is a better path, it must be found or built by human institutions, organized entities that can act beyond the reach of individuals. Institutions embody ideas too detailed, too disciplined, and too rigid to reflect any single person, however powerful; but they can become the powerful reflection of many overlapping lives, almost all of them individually modest.* [105]

Although institutions can be more powerful than individuals, they also have a harder time learning things. Perhaps Argyris and Schön best summed up this thought when they stated that:

> *Organizational learning is not the same thing as individual learning, even when the individuals who learn are members of the organization. There are too many cases in which organizations know less than their members. There are even cases in which the organization cannot seem to learn what every member knows.* [106]

The challenge is to help an organization learn and retain knowledge over time by combining the knowledge of the many people who make it up. As Argyris and Schön say, "Each member of the organization constructs his or her own representation, or image, of the theory-in-use of the whole. That picture is always incomplete...it is the continual, concerted meshing of individual images of self and others, of one's own activity in the context of collective interaction, which constitutes an organization's knowledge of its theory-in-use." [107]

The practitioners that we spoke with agreed that long-term success depends on capturing individual knowledge in the organization. As Dale Lewis of the ZAMBIA ADMADE PROJECT said, the whole point of doing adaptive management is that "once we learn something, it has to become part of our institutional knowledge." Brian Nyberg of the BC FORESTRY INITIATIVE agreed, stating that "because people turn over so fast and because a lot of these projects are run by volunteers, we need to have some way of maintaining awareness of the project, its history, and needs for future action. So obviously there has to be some permanent record kept in the local office where the project leadership is housed." His colleague Norm Bilodeau also agreed, saying that:

> *Capturing learning isn't a legal requirement, but it's a bit of a social imperative so that there's a written history — so that the person who will eventually take over my job will understand the things that I'm deciding now — that needs to be specified. These are things that we now only have between our ears. But we need to write out things like what we will do, what kind of processes will go in place if, for example, there is a significant increase in sedimentation from a certain pattern of timber harvesting. I know it up here [points to his head], but I have got to write that stuff down.*

Build Teams of Project Partners

The business and organizational management sources that we reviewed spent a good deal of time discussing what Senge terms the discipline of "team learning." As Senge writes, "Teams, not individuals, are the fundamental learning unit in modern organizations. This is where 'the rubber meets the road;' unless teams can learn, the organization cannot learn." [108] He goes on to say that the key to team learning is to get the members of the team focusing their efforts in the same direction — in a state of *alignment* in which a group of people function as a whole. [109]

In Senge's book, he is clearly talking about project teams within a large company. In a conservation setting, however, we can apply these same ideas to project teams that may be composed of partners from several organizations. The key here is to make sure that these various partners are all learning as a cohesive team. For example, Brian Nyberg of the BC FORESTRY INITIATIVE strongly emphasized the need for developing learning across partnerships. He said, "Participation in partnerships is absolutely essential. Anybody who is likely to be able to help or hinder the project that is being developed should be brought in early on so they understand what's being done and why, and ideally, so they have the opportunity to find a way to participate themselves." What you need to avoid is a situation where you "make it halfway through the project and find that somebody who doesn't understand what you are doing has enough influence that they can put a stop to your work simply because they didn't ever have a chance to contribute or be brought up to speed."

The practitioners we spoke with said that investing time and energy in sharing learning with your partners can create an important sense of trust. For example, Stephan Forster of the ZAMBIA KANTIPO PROJECT said "we regularly share our monitoring data with local stakeholders and are constantly providing reports to them. As a result, the project is going along smoothly "because the stakeholders have let go. They trust us to work since they don't feel like they have to control everything. We provide them with enough information and include them in enough meetings so that they are informed and participating and give useful feedback on the modification of the workplan."

Interestingly, this sense of partnership can perhaps come more from sharing personal experiences rather than just work information. John Ericho of the PNG PROJECT related the story about how he would spend time with community members that didn't relate to specific objectives or activities in the project workplan. For example, he would spend time strolling through agricultural areas and visiting with people on his day off. He said, "This type of visit is actually the thing that is keeping the project going. The planned things that we do in workshops have their importance, but the relationship that we develop with the people is critical. It's the thing that ultimately makes our project work." At the same time, however, the PNG PROJECT staff also said that bad personal relations can hinder partnerships. For example, they described one barrier to sharing information being a sense that you are giving away secrets to other organizations that are your competition. As Robert Bino said, one reason that RCF does not work with some groups is that "some people want to be territorial. They know the best way to do conservation and want to hold onto it." John Ericho goes on to add, "You're right. There are some

organizations that think they are on the right track and they don't want to share. Fortunately, there still is some sharing. I think that we should share ideas, and we really do."

Norm Bilodeau of the BC Forestry Initiative takes this optimism a step further when he said:

> *Using adaptive management to build teams of partners is very important. Adaptive management and learning by doing are a bit infectious. A supplementary benefit of our efforts has been that people in other organizations (private and government) became interested in participating in the project. This has led to unexpected partnerships and even in unanticipated funding sources. This "lightning rod" aspect of adaptive management has been both surprising and satisfying.*

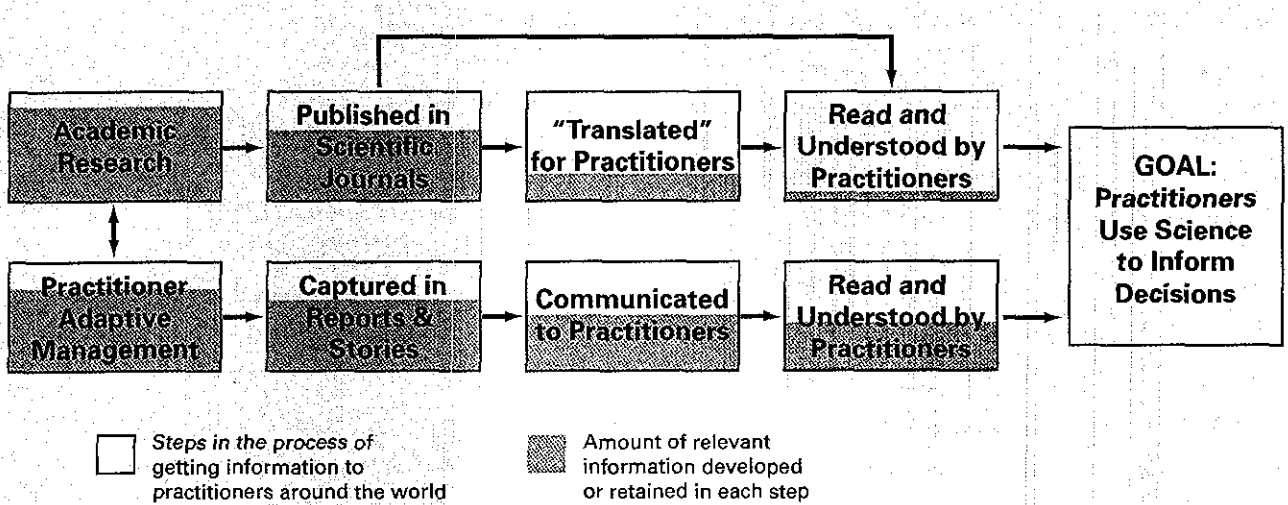
Principle 7: Contribute to Global Learning

Effective adaptive management requires learning at personal and organizational levels. Learning is also important, however, at global levels. Practitioners all around the world are all struggling with similar problems and challenges. If each project team had to start from scratch and learn all of its own lessons, then conservation would be hopeless. If, however, we can learn from one another, then we have a huge head start in our work. Progress can be defined by the building of new knowledge on the foundation of old knowledge. The key is for each project team to make the lessons it has learned available to the rest of the world.

Often, however, practitioners feel like they do not have the skills to provide meaningful insights into the projects they manage or the situations in which they are working. They feel that research and analysis is best left to trained scientists. As a result, they don't take the time to try to share their knowledge with their peers.

We believe that some of the best and most useful learning comes from project managers with no formal science background. All it takes is a strong sense of curiosity and an eagerness to discover and share new and important insights. As project managers are often much more attune to local site conditions and circumstances and they almost intuitively know what interventions have the greatest chance for success, they are often in the best position to carry out the applied experiments necessary to adapt and learn. You never know what influences your results may have outside of your own project area, but chances are, someone will find them very useful. As shown in Figure 5, a key premise behind the approach presented in this guide is that it is practitioners like you who are in the best position to provide meaningful insights into how to do conservation. Getting your results out to the people who can use them the most is not always an easy task. One route often taken by conservation and development projects is to publish their results in journals, newsletters, and brochures. These forms of communication can often enjoy wide audiences, but they are often targeted at specific cross-sections of society. Increasingly, electronic formats such as listservs and Web sites are becoming popular methods for getting lessons out to other practitioners.

FIGURE 5. Two Approaches to Generating and Getting Relevant Information to Practitioners



Access to relevant information is critical to good adaptive management. But where can practitioners around the world get the information they need to do their jobs better? There are two primary avenues by which this can happen. The traditional approach (shown in the top chain in the diagram above) is that the best knowledge and learning is generated by scientists or professional researchers. Scientists, however, often conduct their research somewhat independent of the management objectives of conservation managers. Furthermore, their results are usually published in scientific journals that few practitioners have access to. At best, these technical articles and books are "translated" into more popular pieces with the idea that practitioners will read and understand these documents and then use the information to inform their decisions. The second approach (shown in the bottom chain) holds that it is more effective to have research done by practitioners themselves through adaptive management. Presumably, this research will be on topics that are relevant to practitioners. Furthermore, the results of this work are usually captured in reports, stories, and other communication products that can be easily shared with other conservation practitioners who can then use it in their work.

One of the key assumptions behind this guide is that even if academic research were of higher initial quality than the research done by adaptive managers (a proposition we might dispute), the amount of relevant information that actually reaches project managers (represented by the gray shading) might ultimately be much lower owing to the nature of the information and the problems in communicating the results of academic research to practitioners. In other words, if practitioners do adaptive management themselves, they are much more likely to use the results of their experiments in their own projects — and they will be much more effective in communicating their results to their peers. Of course, as shown by the arrow connecting academic research and adaptive management, perhaps the ideal situation is to have both professionals and practitioners doing research together — collaborating on important issues to address critical conservation concerns.

Encourage Everybody to Do Good Science

The literature sources we reviewed emphasized that although popular conception holds that science is something that can only be done by Ph.Ds in white lab coats using all kinds of fancy research equipment, in reality anyone can do it. As Pirsig writes:

> *A man conducting a gee-whiz science show with fifty thousand dollars' worth of Frankenstein equipment is not doing anything scientific if he knows beforehand what the results of his efforts are going to be. A motorcycle mechanic, on the other hand, who honks the horn to see if the battery works is informally conducting a true scientific experiment. He is testing a hypothesis by putting the question to nature.* [110]

Most of the practitioners that we interviewed agreed with this point. Brian Nyberg of the BC FORESTRY INITIATIVE said quite directly "I certainly believe it is important to contribute to global learning...we want to leave a legacy of learning." Charlotte Harland of the ZAMBIA ADMADE PROJECT agreed, saying that although we haven't really done it yet, it is important to have better dissemination. She feels that doing so "would serve to give us access to other info that would help us do our work — we'll get others to share with us if we share with them." And John Ericho of the PNG PROJECT said that "everyone has to be continually sharing that information, the experience that everyone is gaining from a certain project." He then went on to proudly describe how Crater Mountain project representatives have presented papers at scientific conferences around the world.

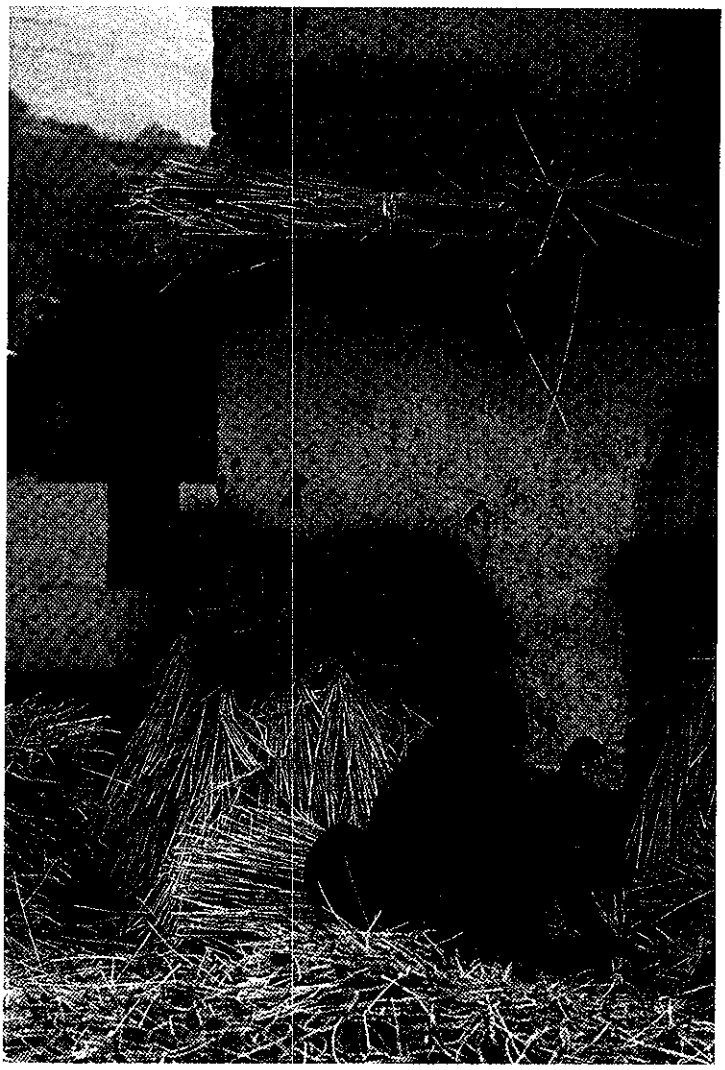
Taking the time to share your learning with other people can also pay unexpected dividends in terms of building your project team's self-esteem. For example, the PNG PROJECT had visitors come from landowners in different parts of the country. As Robert Bino related, "These people went in and talked with the Crater Mountain landowners. We were very impressed with the way the Crater Mountain residents interacted with the visitors. In particular, we got the sense that the locals got a sense of pride to see someone coming from a far away place to seek their advice. And, I think in terms of conservation, it just reinforces the idea that everyone has something to offer — other landowners from different parts of PNG can learn from talking to the Crater Mountain landowners, getting ideas and experience that they can use."

However, the folks we interviewed also warned that you need to target your lessons and that if they are too general, they become meaningless. Perhaps Dale Lewis of the ZAMBIA ADMADE PROJECT said it best:

> *I've been in Zambia a long time — I think I know what motivates people here — it is structures that fit their particular context. This detail is probably boring for anyone else. If you teach the whole world, then it becomes too general. This is why I left academia. My audience is these people in Zambia. I'm here for Zambia right now — a staging ground for Zambian research.*

Likewise, Brian Nyberg of the BC FORESTRY INITIATIVE said "the challenge, I think, for every organization, is how to get the word out to everybody who is potentially interested, without overwhelming people with more than they need." He feels that "a lot of practitioners are just overwhelmed by the blizzard of stuff that comes on to their desks, and they don't know how to sort the wheat from the chaff."

Get the Word Out to Help Other People Find You



One potential benefit of making your results available is that it may alert other people to the work you are doing and prompt them to contact you for more information or even to give you more business. As John Ericho of the PNG PROJECT said "we have a good education officer who used to work with a national newspaper. She's used her contacts to really get the word out about what is going on at Crater Mountain about how we have learned a lot and can share a lot with other people. As a result, now people are knocking on our office door and saying, 'Now, can you come and help us set up our conservation project?'" Likewise, Charlotte Harland of the ZAMBIA ADMADE PROJECT stated that better information dissemination will help their fundraising efforts. Brian Nyberg of the BC FORESTRY INITIATIVE noted that we (the authors of this guide) found out about his work through the information that his project had posted on the Internet.

Making contacts is only helpful up to a point. If you focus too much on getting the word out, you may soon find that you can spend all your time providing information for other people and have no time to do the work that is directly related to your primary mission. For example, Ericho continued his story above by saying "we now have about twenty-three requests for us to come help people set up conservation NGOs or to promote conservation in their areas. This is a good thing, but we don't have the staff or money to help them and it takes a lot of time." His colleague Robert Bino continues, "It can be frustrating when we are unable to assist people who come to our door for help — particularly after we have informed the public concerning the nature of our activities, successes, goals and the mission statement of our organization — because of our limited resources and an existing mammoth task already on our hands to accomplish."

Principle 8: Practice the Art of Adaptive Management

Up until now, we have been talking about the "science" of doing effective adaptive management. We've outlined a series of steps that you need to undertake to achieve adaptive management. And we've presented a series of principles that describe characteristics of projects and organizations that are effective adaptive managers. Our hope is that if you follow these steps and pay attention to these principles, you will be able to improve your ability to do good adaptive management.

However, adaptive management is more than just a science. It is also an art. And like any art such as painting, you can't just learn how to do it by reading about it. If you want to learn how to paint, you need to try painting on your own. You may also want to watch an expert paint or perhaps even serve as an apprentice to a master painter. You also need to cultivate your intuition and develop your sense of what is good and what is bad. And more than anything, you need to practice painting — to do it, look at and critique your efforts, and then try again.

As much as we hope that this guide will help you do effective adaptive management, we know that you can't just read about adaptive management and automatically become an expert in it. Like any craft, you need to try it on your own. You need to develop and pay attention to your feelings about your work. Above all, you need to constantly practice adaptive management.

Treat Adaptive Management as a Craft

Although they are grounded in science, the sources that we reviewed also talked extensively about the artistic aspects of the work. For example, Schön talks about the "art" of practice throughout his book:

> *The practitioner gives an artistic performance. He responds to the complexity, which confuses the student, in what seems like a simple, spontaneous way. His artistry is evident in his selective management of large amounts of information, his ability to spin out long lines of invention and inference, and his capacity to hold several ways of looking at things at once without disrupting the flow of inquiry...[this] art seems to me to be, in considerable measure, a kind of reflection-in-action...a process whose underlying structure is the same: a reflective conversation with a unique and uncertain situation.* [111]

According to Pirsig, instead of trying to remain aloof from the system, a scientist should instead view the research process as a craft or art that is practiced over a lifetime. For Pirsig, science is as much about the journey as it is about the destination:

> *The study of the art of motorcycle maintenance is really a miniature study of the art of rationality itself. Working on a motorcycle, working well, caring, is to become part of a process, to achieve an inner peace of mind. The motorcycle is primarily a mental phenomenon...the real cycle you're working on is a cycle called yourself. The machine that appears to be "out there" and the person that appears to be "in here" are not two separate things. They grow toward Quality or fall away from Quality together.* [112]

The practitioners that we spoke with generally agreed that there is a strong artistic component to the work that they are doing. John Ericho of the PNG PROJECT described how much he feels he has learned over the years of doing his project. He feels that if he were to go off and start a new project, the artistic skills that he has developed means that he would be "much better trained and equipped" to carry out the work. Norm Bilodeau of the BC FORESTRY INITIATIVE agrees, saying that more than anything, his experience has given him a "framework" to approach the problem, a set of skills, and especially "an overarching vision" of how to proceed with adaptive management.

Pay Attention to Your Intuition

Many of the literature sources that we reviewed also emphasized the need to cultivate and pay attention to your intuition. These sources particularly focused on intuition as the source of models and theories that can then be tested. For example, in discussing how a scientific hypothesis gets developed, Pirsig writes, "the true work of the inventor consists in choosing among these combinations so as to eliminate the useless ones...the rules that must guide the choice are extremely fine and delicate. It's almost impossible to state them precisely; they must be felt rather than formulated." [113] In a similar fashion, Schön writes that a reflective practitioner "arrives at a new theory of the phenomenon by articulating a feeling he has about it." [114]

John Ericho of the PNG PROJECT described how they instruct their staff to write progress reports based on their impartial observations, telling their staff "in this report, please tell me what you see without feelings." However, they also want to know from their staff "what is your gut feeling?" As Ericho said, "sometimes your gut can tell you something important, especially when you might be making a mistake." He described one example when a tourist who had a potentially serious medical condition came to the reserve and wanted to go on a long hike. His gut told him that he should try to persuade her not to go, but in the end she insisted and she tragically ended up dying on the trip. Ericho said that although obviously he did not have the power to stop her, he wished he had listened more to his intuition and insisted more strongly that she not go.

Brian Nyberg of the BC FORESTRY INITIATIVE agreed that adaptive management involves a "creative process" and that it's not something "that you can just study in a book." He also cautioned, however, that by saying that adaptive management relies on intuition, it doesn't mean you get a license to do whatever you want. As he said:

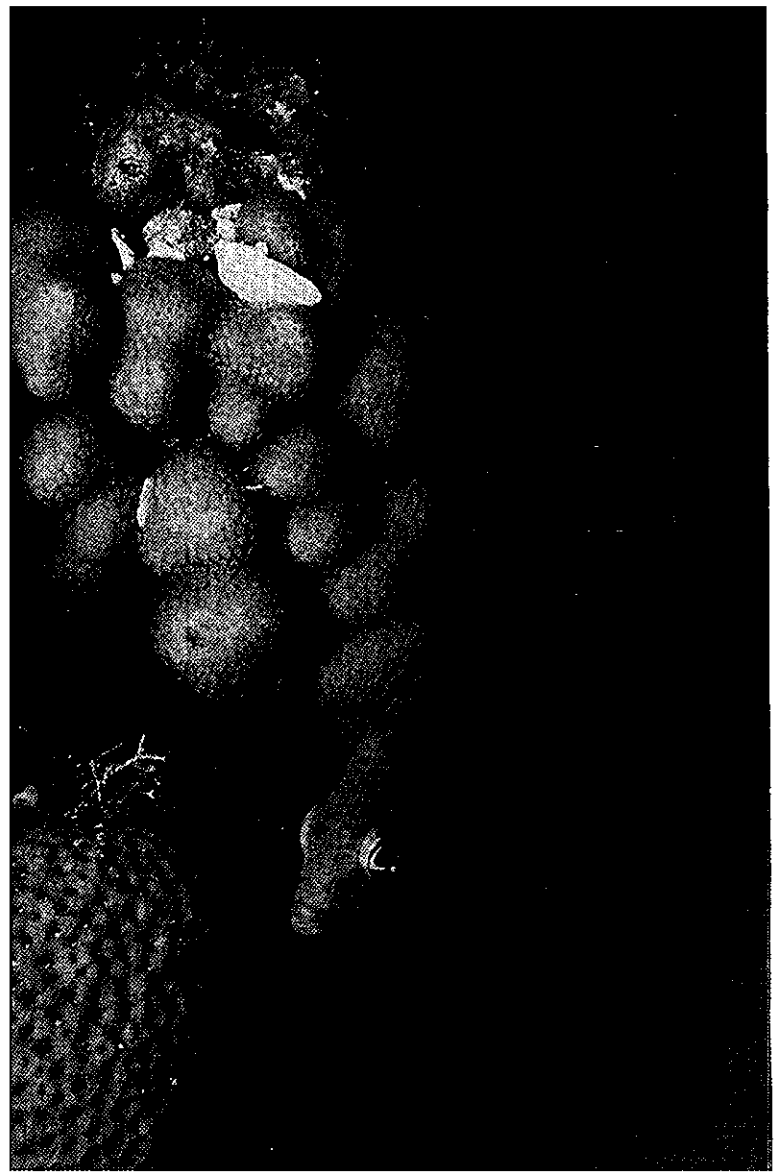
> *The potential danger in this type of artistic principle gets back to the whole notion that a lot of people think adaptive management is nothing but intuition and that there's no structure to it. I'm worried that people can say "I don't like the way things are going here, so I'm going to try something different" and then call that adaptive management. The trick is to find some way to find a balance between science and intuition.*

Practice, Practice, Practice

Finally, the literature sources that we reviewed said that like any art, adaptive management must be practiced to be learned. As Schön says:

> *If it is true that there is an irreducible element of art in professional practice, it is also true that gifted engineers, teachers, scientists, architects, and managers sometimes display artistry in their day-to-day practice. If the art is not invariant, known, and teachable, it appears nonetheless, at least for some individuals, to be learnable. 115*

The practitioners that we spoke with also emphasized that to do good adaptive management, the learning had to be not just technical skills, but also the ability to practice the art of doing it. As Norm Bilodeau of the BC FORESTRY INITIATIVE says, to do good adaptive management as a forester "you don't have to be an expert



engineer" but you do have to be well grounded in the technology that you are using. Bilodeau also argues, however, that to be a good adaptive manager, you also need to be "able to think at multiple scales." And finally, you need experience. But as Bilodeau says, you cannot make an excuse of not having enough experience. Bilodeau tells the story of how he was talking to a senior engineer about doing a complex job and how he was reluctant to try to tackle the job on his own. The engineer said to him "the only difference between my doing this job and your doing it is the number of footprints it's going to take to get it done. So I don't want to hear any more about it. Just start walking." And Bilodeau told us "I've always thought that was really good advice."

WHERE DO WE GO FROM HERE?

AT THIS POINT, WE HAVE COMPLETED a basic survey of a number of different adaptive approaches from different fields and conservation projects. Based on these, we have developed a basic definition of adaptive management. We have described the conditions that warrant taking an adaptive management approach. We have outlined the steps involved in doing adaptive management in conservation projects. And we have determined principles for doing effective adaptive management. In this final section, we consider future directions to further refine our framework for effective adaptive management. Specifically, we focus on:

- Discussing the benefits and costs of an adaptive management approach.
- Applying adaptive management to other scales.
- Proposing a way in which we can test the framework outlined in this guide.

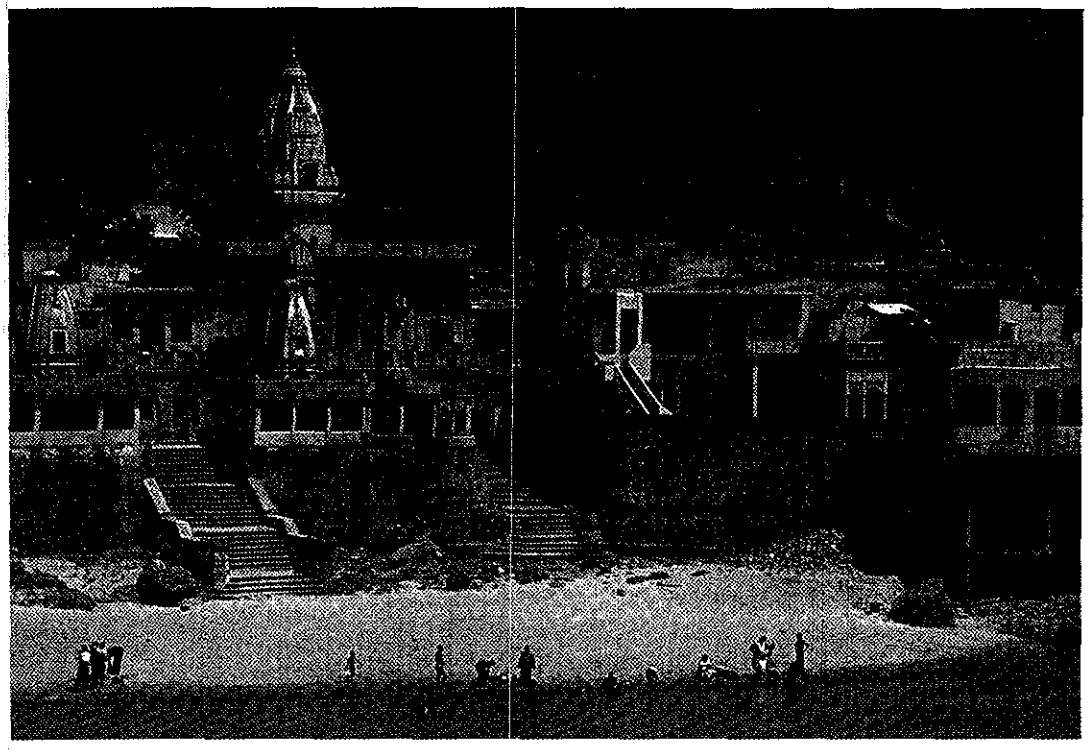
Balancing the Benefits and Costs of Adaptive Management

At this point, we hope it's clear what the potential benefits of adaptive management can be. In particular, benefits of adaptive management are that it provides:

- **A Framework for Better Management** — By systematically testing assumptions and seeing what works and what doesn't, you can change and improve your project.
- **An Opportunity to Learn** — Adaptive management provides a mechanism to learn in an organized and efficient manner about what works, what doesn't, and why. And it can help build learning projects and organizations.

As much as we believe in adaptive management, however, it is also important to understand that adaptive management is not a magic bullet that will automatically cure all problems. Adaptive management has clear benefits, but it also has real costs. It is thus important to understand these costs and benefits so that you can decide when to use adaptive management, and when you should not. Specific costs of adaptive management include: [116]

- **Consequences of Failure** — Adaptive management is about trying different management options to see what works and why. Almost by definition, adaptive managers may end up implementing actions that will be proved not to work. If they are not in an organization that values failure, then the practitioner may be "blamed" for the failure and be subject to reprimands, sanctions, or even lose their job or the confidence of their partners. To this end, it is vital that adaptive managers involve all stakeholders in the process and strive to ensure they are in an environment in which people understand the broader context in which they are working.
- **Bias in Interpreting Results** — By definition, adaptive managers are interested in the outcome of their work. As a result, adaptive managers must beware of what Kai Lee terms "vulnerability to self-interest." There is a moral hazard that managers will consciously or unconsciously bias their results to make themselves look better and achieve the results that they are looking for.
- **Ethical Issues** — Adaptive managers must also beware of the potential impact of their experiments on people's lives. In many cases, people's welfare and lives depend on the natural resources generated by ecosystems. It is thus important to consider the implications of withholding treatment that is presumed to be beneficial or trying "second best" practices in control groups — a problem akin to the ethical challenges faced by medical researchers experimenting with human subjects. It is also important to realize that "failed" policy experiments cannot always be easily abandoned. For example, if a project appoints a group of people to be leaders and later realizes that this is a mistake, it may not be possible to give the leadership role to someone else without a major loss of face for the original leaders.
- **Financial Costs** — There are many steps involved in the adaptive management process. These steps require an investment of money, resources, and especially project staff time. It is expensive to hold meetings to develop a model or to collect and analyze data. It is a lot cheaper (at least in the short run) to just manage by trial-and-error.
- **Need for Long-Term Time Frames** — Experimentation in conservation projects typically requires long periods of time effects to become apparent. It thus also requires patience on the part of all the stakeholders in



the resource. As Norm Bilodeau of the BC FORESTRY INITIATIVE said, "Be patient. Not all experimentation can provide quick answers. Some of most important experiments may take a long time."

Unfortunately, there is no simple cost-benefit equation that can be used to compute whether you should use an adaptive management approach. We can't guarantee that spending an additional $20,000 on adaptive managemenr will buy $50,000 worth of knowledge. However, we hope that with an understanding of both the costs and benefits, you will be in a position to judge for yourself whether this approach makes sense for you.

Applying Adaptive Management at Other Scales

For the most part, in this guide we have focused on applying adaptive management to conservation projects and organizations. Many of these same concepts, however, can be applied to two other scales — portfolios of projects and the discipline of conservation as a whole.

Learning Portfolios

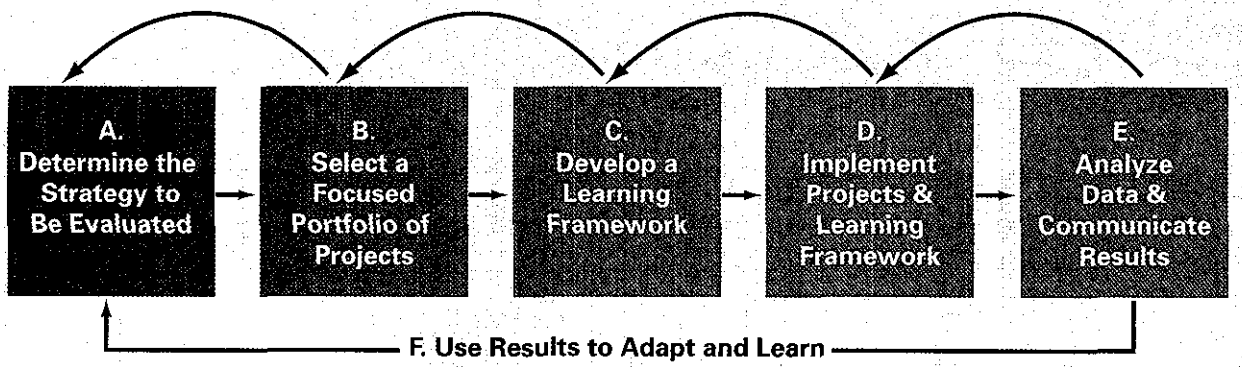
A *learning portfolio* is a group of projects that are all focused on a specific conservation strategy and are dedicated to understanding the conditions under which that strategy is most effective. In a sense, all projects in the learning portfolio work together to evaluate the selected strategy. By including multiple projects at different sites encompassing different biological, social, political, and economic conditions, portfolio participants can compare a variety of experiences to more easily determine what works, what doesn't, and why. A portfolio of projects focused on evaluating the same strategy serve as a sample that provides for a more robust learning experience. Because the projects are all focused on similar problems, there is also much greater potential for cross-project information exchange. As a result, a learning portfolio can be used to test assumptions that are common across multiple projects making it a powerful tool to help the conservation community determine specific and yet non-trivial principles for using these strategies. The process of doing adaptive management in learning portfolios is similar to

the process of doing adaptive management in conservation projects. Figure 6 shows the specific steps in a learning portfolio cycle.

The Discipline of Conservation

Conservation is a truly complex endeavor. While the conservation community has made great progress over the past few years, we have yet to discover the secret to an effective process or "science" of conservation. As a field, we need to have greater understanding of the factors that directly and indirectly affect conservation outcome. We need to know where we are going—what our collective goals are. We have to know how to get there or at least have some way of knowing if we are on the right track. And we need to learn from what we do and from one another and adapt over time. In short, we need to grow the field of conservation.

FIGURE 6. The Steps in Portfolio-Level Adaptive Management



A. Determine the Strategy to Be Evaluated — Determine what strategy you want to evaluate with your portfolio, how you will structure your portfolio, and how you will monitor it over time.

B. Select a Focused Portfolio of Projects — Establish and implement the specific process that you will use for reviewing and selecting the projects in your portfolio.

C. Develop a Learning Framework — With all the project managers in the portfolio, determine general assumptions that all projects will be able to test as well as more specific ones that are relevant to subsets of the overall portfolio. Determine common indicators to be collected and standardized data collection methods to be employed across all projects. Figure out how you and your partners will collect the data necessary to test these assumptions.

D. Implement Projects & Learning Framework — Work with your partners to undertake the projects and monitoring work.

E. Analyze Data & Communicate Results — Analyze your data and communicate the results to your key audiences.

F. Use Results to Adapt and Learn — Use results to make changes across the portfolio and beyond.

Source: Adapted from Salafsky & Margoluis, 1999.

Adaptive management can help us do this. It can provide the necessary framework for individuals and institutions to come together and find common ground. It can give us a common currency and language we can use. And it can make learning across institutions more efficient and productive.

Practicing What We Preach

As you might guess by now, we are strong believers in the power of adaptive management to help conservation be more successful over the long term. And we believe that our definition and the framework of conditions, steps, and principles for effective adaptive management that we have synthesized are sound. But can we be sure? Is adaptive management really the best way forward? Is it the most efficient and effective way to learn? Will practitioners find it useful? Are the steps we outlined and the principles we proposed both necessary and sufficient to achieve conservation through adaptive management?

In thinking about how to answer these questions, the obvious thing to do is to take our own advice and evaluate the adaptive management framework outlined in this guide using the same steps and principles that we have presented in this guide. To this end, we have followed the first few steps in the adaptive management process as shown in Figure 7, making explicit our goal, model, and assumptions behind this guide.

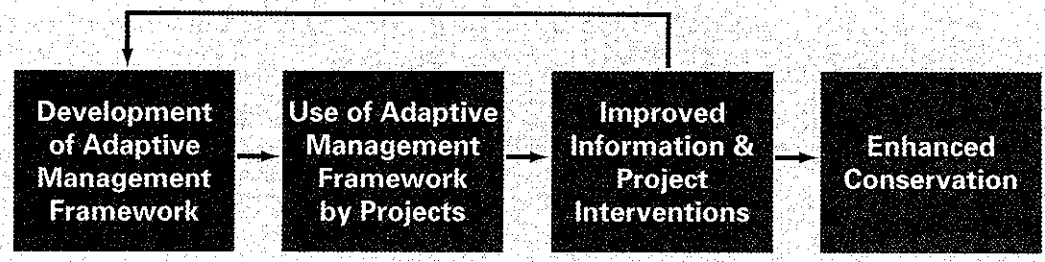
In order to realize the potential of adaptive management, we must test it in projects, institutions, and portfolios, and across the entire field of conservation. Practitioners who wish to learn more about adaptive management and under what conditions it is most useful must find ways to collaborate, learn together, and document what they have learned. For improvements in conservation to occur through adaptive management, there must be broad participation by not only practitioners, but also non-governmental organizations, donors, foundations, academic institutions, and government agencies.

We have not written this guide to be the last word on adaptive management. Our work is based on the work of those who have gone before us. We see this guide as one step in the process of collectively developing a better understanding of adaptive management. We hope you use it to generate new and useful insights into adaptive management and document what you learn along the way so that others may benefit as well.

FIGURE 7. The Goal, Model, and Underlying Assumptions in This Guide

Our Goal: Promote enhanced biodiversity conservation by helping practitioners understand the concepts of adaptive management and how to use it.

Our Model:



Assumptions in This Model:

Development of Adaptive Management Framework

- Development of a framework based on many disciplines is useful to conservation.
- The steps and principles in the framework that we have developed are sufficient.
- This framework can be applied to all project conditions throughout the world.

Use of Adaptive Management Framework by Projects

- Practitioners have access to this guide and other required sources.
- Practitioners find this framework understandable and useful.
- Practitioners have the capacity, time, and resources to apply this framework.

Improved Information and Project Interventions

- Use of the framework leads to projects having better information.
- Having better information enables projects to be more effective and cost-effective.
- We can develop indicators to assess whether projects have better information.
- As practitioners learn about adaptive management, they will contribute to improving the understanding and practice of adaptive management.

Enhanced Conservation

- Improved projects lead to reductions of threats to biodiversity.
- By reducing threats to biodiversity, conservation is achieved.
- We can develop indicators to measure whether conservation is being achieved.

Suggested Readings

Gunderson, L.H., C.S. Holling, and S.S. Light, eds. *Barriers and bridges to the renewal of ecosystems and institutions.* New York: Columbia University Press.

Lee, K. 1993. *Compass and gyroscope: Integrating science and politics for the environment.* Washington D.C.: Island Press.

Margoluis, R. and N. Salafsky. 1998. *Measures of success: Designing, managing, and monitoring conservation and development projects.* Washington D.C.: Island Press.

Nyberg, B. 1999. *An introductory guide to adaptive management for project leaders and participants.* Victoria, British Columbia: BC Forest Service.

Salafsky, N. and R. Margoluis. 1999. *Greater than the sum of their parts: Designing conservation and development programs to maximize results and learning.* Washington D.C.: Biodiversity Support Program.

Schön, D. A. 1983. *The reflective practitioner: How professionals think in action.* New York: Basic Books.

References

Aguayo, R. 1991. *Dr. Deming: The American who taught the Japanese about quality.* New York: Fireside Press.

Argyris, C. and D. A. Schön. 1978. *Organizational learning: A theory of action perspective.* Reading, Massachusetts: Addison-Wesley.

Brinkerhoff, D.W., and M.D. Ingle. 1989. Integrating blueprint and process: A structured flexibility approach to development management. *Public Administration and Development* 9:487-503.

Dewey, J. 1920. *Reconstruction in philosophy.* New York: New American Library.

Drucker, P. 1964. *Managing for results.* New York: Harper and Row.

Friedmann, J. 1987. *Planning in the public domain: From knowledge to action.* Princeton, New Jersey: Princeton University Press.

Funtowicz, S.O. and J.R. Ravetz. 1991. A new scientific methodology for global environmental issues. In R. Costanza, Ed. *Ecological economics. The science and management of sustainability.* New York: Columbia University Press.

Funtowicz, S.O. and J.R. Ravetz. 1994. The worth of a songbird: Ecological economics as a post-normal science. *Ecological Economics,* 10(3):197-207.

Granger, C. H. 1970. How to set company objectives. *Management Review* 59:2-8.

Gunderson, L.H., C.S. Holling, and S.S. Light, eds. *Barriers and bridges to the renewal of ecosystems and institutions.* New York: Columbia University Press.

Holling, C.S., ed. 1978. *Adaptive environmental assessment and management.* New York: John Wiley & Sons.

Holling, C.S. 1995. What barriers? What bridges? In L.H. Gunderson, C.S. Holling, and S.S. Light, eds. *Barriers and bridges to the renewal of ecosystems and institutions,* pp. 3-36. New York: Columbia University Press.

Hughes, C. L. 1965. *Goal setting: Key to individual and organizational effectiveness.* New York: American Management Association.

Kuhn, T. S. 1962. *The structure of scientific revolutions.* Chicago: University of Chicago Press.

Lee, K. 1993. *Compass and gyroscope: Integrating science and politics for the environment.* Washington D.C.: Island Press.

Lewis, D. 1999, *Comparative study of factors influencing ADMADE success.* Lusaka, Zambia: Zambia National Parks and Wildlife Service.

Margoluis, R. and N. Salafsky. 1998. *Measures of success: Designing, managing, and monitoring conservation and development projects.* Washington D.C.: Island Press.

McConkey, D. 1972. Writing measurable objectives for staff managers. *Advanced Management Journal* 37:10-16.

Morrisey, G. L. 1970. *Management by objectives and results in the public sector.* Reading, Massachusetts: Addison-Wesley Publishing.

Nyberg, B. 1999. *An introductory guide to adaptive management for project leaders and participants.* Victoria, British Columbia: BC Forest Service.

Odiorne, G. S. 1965. *Management by objectives.* New York: Pittman.

Pirsig, R. M. 1974. *Zen and the art of motorcycle maintenance: An inquiry into values.* New York: Bantam.

Salafsky, N. and R. Margoluis. 1999. *Greater than the sum of their parts: Designing conservation and development programs to maximize results and learning.* Washington D.C.: Biodiversity Support Program.

Schön, D. A. 1983. *The reflactive practitioner: How professionals think in action.* New York: Basic Books.

Senge, P. M. 1990. *The fifth discipline: The art and practice of the learning organization.* New York: Currency Doubleday.

Tse-tung, M. 1937. On practice. *In Four essays on philosophy.* Beijing: Foreign Language Press.

Walters, C. 1986. *Adaptive management of renewable resources.* New York: MacMillan Publishing Company.

Specific Citations

What Is This Guide About? (pp. 4-7)

1 Margoluis & Salafsky 1998.

2 Salafsky & Margoluis 1999.

Sources for This Guide (pp. 16-29)

3 Funtowicz & Ravetz 1991 and 1994.

4 Pirsig 1974, p. 116.

5 Pirsig 1974, p. 93.

6 Pirsig 1974, p. 93.

7 Pirsig 1974, p. 92.

8 Adapted from Pirsig 1974, pp. 93-94.

9 Funtowicz & Ravetz 1994, p. 197.

10 This section is drawn from Friedmann 1987.

11 Dewey 1920 cited in Friedmann 1987.

12 Tse-tung 1937 cited in Friedmann 1987.

13 Argyris & Schön 1978, p. 13.

14 Argyris & Schön 1978, p. 9.

15 Argyris & Schön 1978, p. 29.

16 Hughes 1965, Granger 1970, McConkey 1972.

17 Drucker 1964, Odiorne 1965, Morrisey 1970.

18 Aguayo 1991.

19 Brinkerhoff & Ingle 1989.

20 Senge 1990, p. 68.

21 Senge 1990, p. 69.

22 Senge 1990, p. 71.

23 Senge, 1990, pp. 7-10.

24 Schön 1983, pp. 42-43.

25 Schön 1983, p. 40.

26 Schön 1983, p. 68.

27 Schön 1983, p. 147.

28 Introduction adapted from Lee 1993.

29 The four conditions presented here are adapted from Holling 1978 and 1985.

30 Lee 1993, p. 58.

31 Lee 1993, p. 9.

32 Lewis 1999. p. 1.

33 Lewis 1999. p. 1.

34 Materials in this section adapted from the Ministry of Forests Web site www.gov.bc.ca/for (12/20/00)

35 Nyberg 1999.

Steps in the Process of Adaptive Management (pp.30-65)

36 Margoluis & Salafsky 1998, p. 16.

37 Pirsig 1974, p. 93.

38 Schön 1983, p. 40.

39 Senge 1990, pp. 172 and 226.

40 Senge 1990, p. 9.

41 Margoluis & Salafsky 1998, p. 28.

42 Senge 1990, p. 175.

43 Senge 1990, p. 315.

44 Schön 1983, p. 40.

45 Lee 1993, p. 61.

46 Lee 1993, p. 61.

47 Argyis & Schön 1978, p. 11.

48 Pirsig 1974, p. 94.

49 Lee 1993, p. 62.

50 Lee 1993, p. 62.

51 Senge 1990, p. 175.

52 Argyis & Schön 1978, p. 17.

53 Margoluis & Salafsky 1998, p. 64.

54 Margoluis & Salafsky 1998, p. 73.

55 Senge 1990, pp. 303-304.

56 Argyis & Schön 1978, p. 160.

57 Senge 1990, p. 64.

58 Holling 1995, p. 27.

59 Senge 1990, p. 64.

60 Lee 1993, p. 53.

61 Walters 1986, p. 73.

62 Schön 1983, pp. 145-146.

63 Schön 1983, p. 147.

64 Schön 1983, pp. 149-150.

65 Lee 1993, p. 75.

66 Margoluis & Salafsky 1998, pp. 84-103.

67 Pirsig 1974, p. 93.

68 Argyris & Schön 1978, p. 11.

69 Senge 1990, p. xix.

70 Pirsig 1974, p. 95.

71 Lee 1993, p. 53.

72 Schön 1983, p. 68.

73 Schön 1983, p. 147.

74 Pirsig 1974, p. 93.

75 Lee 1993, p. 62.

76 Pirsig 1974, p. 96.

77 Pirsig 1974, pp. 238-239.

78 Pirsig 1974, p. 96.

79 Schön 1983, p. 62.

80 Senge 1990, p. 22.

81 Pirsig 1974, p. 95.

82 Pirsig 1974, p. 96.

83 Argyis & Schön 1978, pp. 2-3.

84 Pirsig 1974, pp. 92-93.

85 Schön 1983, pp. 132.

Principles for the Practice of Adaptive Management (pp. 66-91)

86 Lee 1993, pp. 80-81.

87 Lee 1993, p. 81.

88 Senge 1990, p. 4.

89 Senge 1990, p. 299.

90 Pirsig 1974, p. 95.

91 Lee 1993, p. 53.

92 Senge 1990, p. 154.

93 Senge 1990, p. 226.

94 Senge 1990, p. 172.

95 Pirsig 1974, p. 106.

96 Schön 1983, p. 68.

97 Kuhn 1962, p. 75.

98 Holling 1995, pp. 21-22.

99 Gunderson et al. 1995, p. xi.

100 Holling 1995, pp. 21-22.

101 Argyris & Schön 1978, p. 4.

102 Senge 1990, p. 139.

103 Senge 1990, p. 4.

104 Senge 1990, p. 172.

105 Lee 1993, pp. 4-5.

106 Argyris & Schön 1978, p. 9.

107 Argyris & Schön 1978, p. 16.

108 Senge 1990, p. 10.

109 Senge 1990, p. 234.

110 Pirsig 1974, p. 49.

111 Schön 1983, p. 130.

112 Pirsig 1974, p. 293.

113 Pirsig 1974, p. 240.

114 Schön 1983, p. 63.

115 Schön 1983, p. 18.

Where Do We Go From Here? (pp.92-96)

116 The following section adapted in part from Lee 1994.

About the Biodiversity Support Program

The Biodiversity Support Program (BSP) is a consortium of World Wildlife Fund, The Nature Conservancy, and World Resources Institute, funded by the United States Agency for International Development (USAID). BSP's mission is to promote conservation of the world's biological diversity. We believe that a healthy and secure living resource base is essential to meet the needs and aspirations of present and future generations. BSP began in 1988 and will close down in December 2001.

A Commitment to Learning

Our communications activities are designed to share what we are learning through our field and research activities. To accomplish this, we try to analyze both our successes and our failures. We hope our work will serve conservation practitioners as a catalyst for further discussion, learning, and action so that more biodiversity is conserved. Our communications programs include print publications, Web sites, presentations, and workshops.

BSP Web Sites

We invite you to visit our Web sites.

***Biodiversity Support Program**
www.BSPonline.org

***Biodiversity Conservation Network**
www.BCNet.org

CARPE: Central African Regional Program for the Environment
http://carpe.umd.edu

• Until the end of 2006, these two sites will be available at the addresses above. WWF-US will be hosting these sites on the WWF site at www.worldwildlife.org. BSP thanks WWF for providing this service.

BSP Publications

Many of our publications are available online at **www.BSPonline.org**. On our home page, click on publications. You can view **publications** online until the end of 2006. You may contact us by mail, phone, or fax until December 2001.

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Foundations of Success (FOS) is a legacy of BSP, born out of its Analysis and Adaptive Management (AAM) Program and the Biodiversity Conservation Network (BCN). FOS is a non-profit organization dedicated to improving the practice of conservation by working with practitioners to develop and communicate tested knowledge about what works, what dosen't, and why. FOS works with conservation practitioners around the world to clearly define conservation success, develop guiding principles, and build the capacity to do adaptive management. FOS operates as a network of learning protfolios — clusters of projects focused on testing specific conservation tools or strategies. FOS partners share and document lessons learned and contribute to building capacity throughout the FOS network. For more information on Foundations of Success, go to **www.FOSonline.org** or send an e-mail to **info@FOSonline.org**.